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Analysis: $C_9H_3Cl_3IN_3O$
Calculated: C, 26.84; H, 0.75; N, 10.44;
I, 31.54.
Found: C, 26.87; H, 0.77; N, 10.27;
I, 30.61

This compound is referred to hereinafter as Compound 70.

Example XIX

Preparation of 4,6-dibromo-2-(2',4'-dichlorophenoxy)-1,3,5-triazine

A 4.0 gram (0.01 mole) portion of 2,4-dichloro-6-(2',4'-dichlorophenoxy)-1,3,5-triazine prepared in a manner similar to Example III was dissolved in 200 milliliters of toluene. HBr gas was continuously bubbled through the refluxing mixture for a period of 5 hours. The reaction mixture was cooled to room temperature and nitrogen gas was bubbled through the mixture to remove any excess HBr. The reaction mixture was then evaporated to dryness and the residue recrystallized from CH_2Cl_2 /hexane to give 1.97 grams (0.005 mole) of 4,6-dibromo-2-(2',4'-dichlorophenoxy)-1,3,5-triazine as silver gray crystals having a melting point of 174°C-176°C. Elemental analysis of the product indicated the following:

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Analysis: $C_9H_3Br_2Cl_2N_3O$
Calculated: C, 27.00; H, 0.75; N, 10.50;
Cl, 17.50
Found: C, 27.41; H, 0.65; N, 10.01;
Cl, 16.70

This compound is referred to hereinafter as Compound 71.

Example XX

Preparation of 2-(4'-chlorophenoxy)-4,6-
difluoro-1,3,5-triazine

Into a stirred solution containing 3.91 grams (0.03 mole) of cyanuric fluoride in 150 milliliters of acetone was added dropwise a mixture containing 3.72 grams (0.03 mole) of 4-chlorophenol and 3.10 grams (0.03 mole) of 2,6-lutidine at a temperature of 0°C. After stirring for about 16 hours, the reaction mixture was poured onto ice causing an oil to separate. The oil was taken up into ether, washed with 0.5 N NaOH, then water, and dried. Evaporation gave a white solid, which was recrystallized from hexane and vacuum sublimed to give 0.47 gram (0.002 mole) of 2-(4'-chlorophenoxy)-4,6-difluoro-1,3,5-triazine having a melting point of 81°C-82.5°C. Elemental analysis of the product indicated the following:

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Analysis: $C_9H_9ClFN_3O_4$
Calculated: C, 44.74; H, 1.67; N, 17.39
Found: C, 44.80; H, 1.72; N, 17.23

This compound is referred to hereinafter as Compound 72.

Example XXI

Preparation of 2-fluoro-4,6-bis-(4'-chlorophenoxy)-1,3,5-triazine

Into a mixture containing 3.72 grams (0.03 mole) of 4-chlorophenol and 3.10 grams (0.03 mole) of 2,6-lutidine in 15 milliliters of acetone was added, with magnetic stirring and cooling at a temperature of 0-5°C, a solution containing 3.91 grams (0.03 mole) of cyanuric fluoride in 185 milliliters of acetone. After stirring at a temperature of 0-5°C for one hour, the mixture was stirred at ambient temperature for about 70 hours. The mixture was then stirred and heated under reflux for about 28 hours, cooled to room temperature and poured onto ice to give a solid. The solid was water-washed, taken up in toluene and the resulting solution washed successively with 0.5 N NaOH and water, then dried over $MgSO_4$ and evaporated under reduced pressure. The resulting solid was recrystallized from hexane to give 1.20 grams (0.003 mole) of a first crop of 2-fluoro-4,6-bis-(4'-chlorophenoxy)-1,3,5-triazine having a melting

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point of 149°C-150°C. Elemental analysis of the product indicated the following:

Analysis: $C_{15}H_8N_3O_2Cl_2F$

Calculated: C, 51.15; H, 2.29; N, 11.93; F, 5.39

Found: C, 51.20; H, 2.21; N, 11.89; F, 5.16

This compound is referred to hereinafter as Compound 73.

Example XXII

Preparation of 2,4-dichloro-6-(4'-sec-butylloxyphenoxy)-1,3,5-triazine

Part A: Preparation of 4-(sec-butylloxy)phenol

Into a 500 milliliter round bottom flask under a nitrogen atmosphere was added NaOH (2.91 grams, 0.07 mole) and 125 milliliters of 1:1 water/dioxane (degassed). When all of the NaOH had dissolved, hydroquinone (4.0 grams, 0.04 mole) was added and the resulting solution immediately turned dark brown. At this time, 2-iodobutane (4.15 milliliters, 0.04 mole) dissolved in 5 milliliters of dioxane was added and the mixture was stirred for 72 hours at room temperature and then acidified with 10% aqueous HCl solution to a pH of about 2. The aqueous solution was extracted with EtOAc (2 x 150 milliliters) and the combined extracts were washed

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with water, saturated NaCl, dried (MgSO_4) and concentrated in vacuo to give a crude product mixture. This mixture was purified by flash chromatography to give a small amount of dialkylated product. 2.31 grams (0.01 mole) of 4-(sec-butyloxy)-phenol and starting hydroquinone in order of elution. NMR analysis of the product indicated the following: NMR (CDCl_3) δ 0.95 (t, 3H, $J=7\text{Hz}$), 1.29 (d, 3H, $J=6\text{Hz}$), 1.29-1.40 (m, 2H), 4.12 (sextet, 1H, $J=6\text{Hz}$), 6.35 (br s, 1H), 6.72 (s, 4H) ppm.

Part B: Preparation of 2,4-dichloro-6-

(4'-sec-butyloxyphenoxy)-1,3,5-triazine

Into a 100 milliliter 3-necked round bottom flask equipped with a thermometer, addition funnel and nitrogen inlet was added cyanuric chloride (2.22 grams, 0.01 mole) dissolved in 20 milliliters of acetone. After cooling to a temperature of 0-5°C, 4-(sec-butyloxy) phenol (2.0 grams, 0.01 mole) prepared in Part A and 2,6-lutidine (1.40 milliliters, 0.01 mole) dissolved in 20 milliliters of acetone were slowly added dropwise via the addition funnel. The temperature of the reaction was maintained between 0-5°C during the addition. The reaction mixture was then stirred at room temperature for a period of 16 hours. After this period, the reaction mixture was filtered through a Celite pad and the pad rinsed with acetone. Ice-water was added and the oil which precipitated was extracted with EtOAc. The EtOAc layers were washed with water, dried (MgSO_4) and concentrated to give a brown semi-solid. The crude product was

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purified by flash chromatography on silica (eluent 10% EtOAc/hexane) to give 2.43 grams (0.008 mole) of 2,4-dichloro-6-(4'-sec-butyloxyphenoxy)-1,3,5-triazine as pale yellow crystals having a melting point of 52.0°C-55.0°C. Elemental analysis of the product indicated the following:

Analysis: $C_{13}H_{13}Cl_2N_3O_2$

Calculated: C, 49.70; H, 4.17; N, 13.37

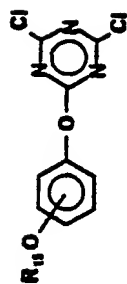
Found: C, 50.26; H, 4.51; N, 13.10

This compound is referred to hereinafter as Compound 74.

Example XXIII

In a manner similar to that employed in Example XXII, other compounds were prepared. The structures and analytical data for Compounds 75 through 83, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table D below.

TABLE D
Representative Heterocyclic Nitrogen - Containing Compounds




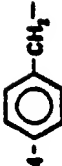

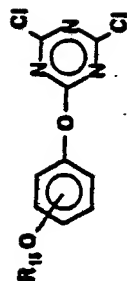


| Compound No. | Substituents | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|---|--------------------|------|-------|-------|------|-------|--------------------|
| | | Calculated | | | Found | | | |
| | | C | H | N | C | H | N | |
| 75 | 4-n-C ₄ H ₉ | 49.70 | 4.17 | 13.37 | 49.66 | 4.27 | 13.32 | 51.0-52.5 |
| 76 | 4-n-C ₇ H ₁₅ | 53.94 | 5.38 | 11.80 | 53.96 | 5.33 | 11.87 | 51.5-53.5 |
| 77 |  | 52.96 | 4.44 | 12.35 | 53.30 | 4.58 | 12.02 | 95.0-96.0 |
| 78 |  | 55.19 | 3.18 | 12.07 | 55.98 | 3.42 | 11.22 | 130.5-132.5 |
| 79 |  | 62.28 | 3.56 | 9.90 | 60.82 | 3.74 | 10.28 | 174.0-176.0 |

TABLE D (cont.)
Representative Heterocyclic Nitrogen - Containing Compounds



| Compound No. | Substituents | Elemental Analysis | | | | | | | | Melting Point (°C) |
|--------------|--|--------------------|------|-------|-------|------|-------|-----------|--|--------------------|
| | | Calculated | | | Found | | | N | | |
| | | C | H | N | C | H | | | | |
| 80 | 3-CH ₃ | 44.14 | 2.59 | 15.44 | 44.13 | 2.67 | 15.68 | 86.0-89.0 | | |
| 81 | 3-n-C ₄ H ₉ | 49.70 | 4.17 | 13.37 | 49.92 | 4.49 | 13.42 | 46.0-48.0 | | |
| 82 |  | 52.96 | 4.44 | 12.35 | 52.51 | 4.41 | 12.69 | 011 | | |
| 83 |  | 55.19 | 3.18 | 12.06 | 59.64 | 3.89 | 10.28 | 011 | | |

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Example XXIVPreparation of 4-chloro-6-methyl-2-(2',4'-dichlorophenoxy)-1,3,5-triazine

Into a solution containing 5.0 grams (0.02 mole) of 2,4-dichloro-6-(2',4'-dichlorophenoxy)-1,3,5-triazine prepared in a manner similar to Example III in 400 milliliters of dry tetrahydrofuran was added dropwise 5.9 milliliters of a 2.7M solution of methylmagnesium bromide in ether at a temperature of 0°C. The resulting mixture was stirred at room temperature under a nitrogen atmosphere for about 18 hours. The mixture was concentrated and the residue purified by flash column chromatography on silica gel using 10% EtOAc in hexane to give 2.00 grams (0.007 mole) of 4-chloro-6-methyl-2-(2',4'-dichlorophenoxy)-1,3,5-triazine having a melting point of 107°C-108°C. Elemental analysis of the product indicated the following:

Analysis: $C_{10}H_6Cl_3N_3O$ Calculated: C, 41.34; H, 2.08; N, 14.46;
Cl, 36.61Found: C, 41.35; H, 2.39; N, 14.46;
Cl, 36.85

This compound is referred to hereinafter as Compound
84.

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Example XXVPreparation of 4-bromo-6-methyl-2-(2',4'-dichlorophenoxy)-1,3,5-triazine

Into a solution containing 2.0 grams (0.007 mole) of 4-chloro-6-methyl-2-(2',4'-dichlorophenoxy)-1,3,5-triazine prepared in Example XXIV in 300 milliliters of CH_2Cl_2 was bubbled dry HBr gas for a period of 3 hours. The mixture was allowed to stand at room temperature for about 18 hours. The suspension was then filtered and the solids partitioned between NaHCO_3 solution and CH_2Cl_2 . The organic layer was dried over anhydrous Na_2SO_4 and the solvent evaporated to give 0.7 gram (0.002 mole) of 4-bromo-6-methyl-2-(2',4'-dichlorophenoxy)-1,3,5-triazine having a melting point of 123°C-127°C. Elemental analysis of the product indicated the following:

Analysis: $\text{C}_{10}\text{H}_6\text{BrCl}_2\text{N}_3\text{O}$

Calculated: C, 35.85; H, 1.81; N, 12.54;
Cl, 21.17; Br, 23.85

Found: C, 36.22; H, 2.15; N, 12.46;
Cl, 22.00; Br, 21.20

This compound is referred to hereinafter as Compound 85.

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Example XXVIPreparation of 4-chloro-6-methyl-2-
(1-naphthoxy)-1,3,5-triazine

Into a solution containing 5.0 grams (0.02 mole) of 4,6-dichloro-2-(1-naphthoxy)-1,3,5-triazine prepared in Example IX in 300 milliliters of tetrahydrofuran at 4°C was added dropwise 7.0 milliliters of 2.7M methylmagnesium bromide in 200 milliliters of tetrahydrofuran. The resulting mixture was stirred at room temperature for about 18 hours and then evaporated. The residue was purified by flash column chromatography on silica gel using 7% ethyl acetate in hexane to give 2.0 grams (0.007 mole) of 4-chloro-6-methyl-2-(1-naphthoxy)-1,3,5-triazine having a melting point of 80°C-83°C. (recrystallized from CH₂Cl₂-hexane). Elemental analysis of the product indicated the following:

Analysis: C₁₄H₁₀ClN₃O
Calculated: C, 61.89; H, 3.71; N, 15.46; Cl, 13.05
Found: C, 61.86; H, 3.72; N, 15.46;
Cl, 13.07

This compound is referred to hereinafter as Compound 86.

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Example XXVIIPreparation of 2-chloro-4-methoxy-6-
(2',4'-dichlorophenoxy)
-1,3,5-triazine

Into a stirred solution containing 10.0 grams (0.03 mole) of 2,4-dichloro-6-(2',4'-dichlorophenoxy)-1,3,5-triazine in 200 milliliters of acetone was added 3.49 grams (0.03 mole) of 2,6-lutidine at a temperature of 0°C-5°C. To this mixture was added dropwise 1.03 grams (0.03 mole) of methanol while warming to room temperature. The mixture was heated to 50°C and maintained for about 6 hours, then cooled to room temperature and stirred for about 60 hours. Lutidine hydrochloride was filtered off, the solvent evaporated, and the residue dissolved in ether and dried over MgSO_4 . The solution was flash chromatographed on a silica column, eluting with CH_2Cl_2 /hexane (9:1). Evaporation of solvent gave 3.14 grams of crystalline product which was recrystallized from hexane to give 1.86 grams (0.006 mole) of 2-chloro-4-methoxy-6-(2',4'-dichlorophenoxy)-1,3,5-triazine having a melting point of 87°C-89°C. Elemental analysis of the product indicated the following:

Analysis: $\text{C}_{10}\text{H}_6\text{Cl}_3\text{N}_3\text{O}_2$
Calculated: C, 38.67; H, 1.97; N, 13.71
Found: C, 38.94; H, 2.00; N, 14.09

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This compound is referred to hereinafter as Compound 87.

Example XXVIII

Preparation of 4,6-bis-
(2',2',2'-trifluoroethoxy)
-2-phenyl-1,3,5-triazine

Into a stirred suspension containing 1.06 grams (0.02 mole) of NaH (50% in oil) in 30 milliliters of dry tetrahydrofuran was added dropwise a solution containing 1.72 milliliters (0.01 mole) of 2,2,2-trifluoroethanol in 10 milliliters of dry tetrahydrofuran at a temperature of 4°C. This mixture was stirred at room temperature under a nitrogen atmosphere for 20 minutes. The mixture was then transferred into an addition funnel under a nitrogen atmosphere and added dropwise to a solution of 5.0 grams (0.02 mole) of 4,6-dichloro-2-phenyl-1,3,5-triazine in 60 milliliters of dry tetrahydrofuran at room temperature, stirred for about 18 hours and then evaporated to dryness. The residue was purified by flash column chromatography on silica gel using 2% EtOAc in hexane to give 0.9 gram of a crude product which was recrystallized from CH_2Cl_2 -hexane to give 0.48 gram (0.001 mole) of 4,6-bis-(2',2',2'-trifluoroethoxy)-2-phenyl-1,3,5-triazine as white plates having a melting point of 92°C-93°C. Elemental analysis of the product indicated the following:

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Analysis: $C_{13}H_9N_3O_2F_6$
Calculated: C. 44.20; H. 2.57; N. 11.89; F. 32.27
Found: C. 44.51; H. 2.57; N. 12.03; F. 31.56

This compound is referred to hereinafter as Compound 88.

Example XXIX

Preparation of 4-chloro-6-
(2',2',2'-trifluoroethoxy)
-2-phenyl-1,3,5 triazine

The column chromatography fractions from Example XXVIII were examined and a group identified as containing 4-chloro-6-(2',2',2'-trifluoroethoxy)-2-phenyl-1,3,5-triazine as a second component. These were combined and purified by preparative liquid chromatography (silica gel) using 10% ethyl acetate in hexane as the eluent to give 320 milligrams (0.001 mole) of 4-chloro-6-(2',2',2'-trifluoroethoxy)-2-phenyl-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

Analysis: $C_{11}H_7ClF_3N_3O$
Calculated: C. 45.61; H. 2.44; N. 14.51;
Cl. 12.24; F. 19.68
Found: C. 45.43; H. 2.41; N. 14.45;
Cl. 12.28; F. 18.02

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This compound is referred to hereinafter as Compound 89.

Example XXX

Preparation of 2-chloro-4-(2',4'-dichlorophenoxy)-6-(diethoxyphosphinyl)-1,3,5-triazine

Part A. Preparation of 2,4-dichloro-6-(diethoxyphosphinyl)-1,3,5-triazine

Into a stirred solution containing 36.9 grams (0.02 mole) of cyanuric chloride in 150 milliliters of toluene was added 33.2 grams (0.02 mole) of triethyl phosphite in small portions. The exothermic reaction was controlled by cooling in an ice bath until it ceased. The reaction mixture was stirred and heated for about 18 hours at a temperature of 60°C-90°C. Toluene was removed under reduced pressure and the residue extracted with hexane. After filtering through Celite, the crude product of 2,4-dichloro-6-(diethoxyphosphinyl)-1,3,5-triazine showed the following NMR spectrum (CCl₃): δ 1.15-1.65 ppm (3H, t, CH₃), 4.16-4.75 (2H, pentet, CH₂). This product was used in Part B without purification.

Part B. Preparation of 2-chloro-4-(2',4'-dichlorophenoxy)-6-(diethoxyphosphinyl)-1,3,5-triazine

A 10 gram (0.035 mole) portion of 2,4-dichloro-6-(diethoxyphosphinyl)-1,3,5-triazine prepared in Part A was dissolved in 50 milliliters

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of acetone and the resulting solution was added over a period of 15 minutes to a stirred mixture of 102 grams of ice and 54 milliliters of water. To this stirred suspension was added a solution containing 5.7 grams (0.035 mole) of 2,4-dichlorophenol in 18 milliliters of 8% aqueous sodium hydroxide. This mixture was stirred at 0-5°C for 1 hour and then at room temperature for an additional 1 hour. The aqueous layer was decanted away and the organic residue taken up in ether and water-washed, dried, filtered and the solvent evaporated to give 9.1 grams (0.02 mole) of 2-chloro-4-(2',4'-dichlorophenoxy)-6-(diethoxyphosphinyl)-1,3,5-triazine as an oily residue product. Elemental analysis of the product indicated the following:

Analysis: $C_{13}H_{13}ClN_3O_4P$
Calculated: C, 37.84; H, 3.18; P, 7.51;
Cl, 25.78
Found: C, 38.93; H, 3.43; P, 7.37; Cl,
25.32

This compound is referred to hereinafter as Compound 90.

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Example XXXIPreparation of 2,4-dichloro-6-
(2'-carbomethoxyphenylsulfonylamino)
-1,3,5-triazine

A mixture of 5.7 grams (0.03 mole) of cyanuric chloride and 7.11 grams (0.03 mole) of the sodium salt of 2-carbomethoxybenzenesulfonamide in 150 milliliters of toluene was stirred at room temperature for a period of 20 minutes. The mixture was then heated to 80°C for 3 hours, filtered hot and the filtrate diluted with hexane and cooled. A white solid precipitated and was collected by suction and dried to give 3.0 grams (0.008 mole) of 2,4-dichloro-6-(2'-carbomethoxyphenylsulfonylamino)-1,3,5-triazine having a melting point of 212°C-215°C. Elemental analysis of the product indicated the following:

Analysis: $C_{11}H_8Cl_2N_4O_4S$

Calculated: C, 36.38; H, 2.22; N, 15.42

Found: C, 38.36; H, 1.63; N, 15.42

This compound is referred to hereinafter as Compound 91.

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Example XXXIIPreparation of 2-(2',4'-dichloro-alpha-methylbenzyloxy)-4,6-dichloro-1,3,5-triazine

Into a solution containing 7.4 grams (0.04 mole) of cyanuric chloride in 50 milliliters of acetone under a nitrogen atmosphere and cooled to 0°C was added dropwise a mixture of 7.6 grams (0.04 mole) of 2,4-dichloro-alpha-methylbenzyl alcohol and 4.3 grams (0.04 mole) of 2,6-lutidine and 25 milliliters of acetone. The resulting dark red reaction mixture was stirred at 0°C for 30 minutes during which time a white precipitate formed. Stirring at room temperature was continued for 2 days. The precipitate was then separated by filtration and the filtrate concentrated under reduced pressure. The unreacted cyanuric chloride was distilled out using a Kugelrohr apparatus (.25 mmHg, 50-70°C). The dark residue was then chromatographed on silica gel employing a 9:1 hexane - EtOAc eluent. This furnished 5.0 grams of an orange-yellow oil which was distilled using a Kugelrohr apparatus and a diffusion pump (10^{-4} mm Hg; 120°C) to yield 2.0 grams of a colorless solid. Recrystallization from hexane gave 1.4 grams (0.004 mole) of 2-(2',4'-dichloro-alpha-methylbenzyloxy)-4,6-dichloro-1,3,5-triazine as colorless needles having a melting point of 97.5°C-99.5°C. Elemental analysis of the product indicated the following:

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Analysis: $C_{11}H_7Cl_4N_3O$

Calculated: C, 38.97; H, 2.08; N, 12.40

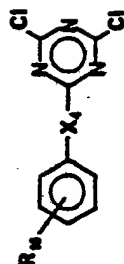
Found: C, 39.02; H, 1.82; N, 12.58

This compound is referred to hereinafter as Compound 92.

Example XXXIII

In a manner similar to that employed in Example XXXII, other compounds were prepared. The structure and analytical data for Compounds 93 through 95, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table E below.

TABLE E
Representative Heterocyclic Nitrogen - Containing Compounds



| Compound No. | Substituents | | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|---------------------|--------------------------------|--------------------|------|-------|-------|------|-------|--------------------|
| | R ₁₆ | X ₄ | Calculated | | | Found | | | |
| | | | C | H | N | C | H | N | |
| 93 | 2,4-Cl ₂ | -CH ₂ O- | 36.96 | 1.55 | 12.93 | 37.10 | 1.61 | 12.77 | 99.0-103.5 |
| 94 | 2,4-Cl ₂ | -CH-O- CN | 37.75 | 1.15 | 16.01 | 38.06 | 1.34 | 16.19 | 96.0-98.5 |
| 95 | H | -CH-O- CF ₃ | 40.77 | 1.87 | 12.97 | 40.90 | 2.04 | 12.76 | 68.0-70.0 |

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Example XXXIVPreparation of 2,4-dichlorobenzaldehyde O-
(4,6-dichloro-1,3,5-triazin-2-yl)oximePart A. Preparation of 2,4-dichlorobenzaldehyde
oxime

Into a solution containing 8.8 grams (0.13 mole) of hydroxylamine hydrochloride in 20 milliliters of water cooled to a temperature of 0°C was added 10.6 grams (0.13 mole) of sodium bicarbonate and a solution of 14.7 grams (0.08 moles) of 2,4-dichlorobenzaldehyde in 50 milliliters of ethanol. Stirring at room temperature and under nitrogen pressure was continued for 3 1/2 hours. The reaction mixture was then diluted with 150 milliliters of water and extracted with CH_2Cl_2 (3 x 100 milliliters). The combined organic layers were dried over MgSO_4 and concentrated under reduced pressure to yield 15.7 grams of a colorless solid. Chromatography on silica gel using dichloromethane as the eluent furnished 14.2 grams (0.07 mole) of 2,4-dichlorobenzaldehyde oxime as a colorless solid. The NMR spectrum of this material indicated the following: NMR (CDCl_3) δ 7.21 (1H, dd, J=9.2Hz), 7.40 (1H, d, J=2Hz), 7.75 (1H, d, J=9Hz), 8.09 (1H, s), 8.49 (1H, s) ppm.

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Part B. Preparation of 2,4-dichlorobenzaldehyde
O-(4,6-dichloro-1,3,5 triazin-2-yl)oxime

2,4-Dichlorobenzaldehyde oxime prepared in Part A was reacted with cyanuric chloride using a procedure similar to that described in Example XXXII above. The reaction mixture was filtered to remove the precipitate and the filtrate was poured onto ice causing a yellow solid to form. The solid was separated and recrystallized from acetone-water to yield 2.1 grams (0.006 mole) of 2,4-dichlorobenzaldehyde O-(4,6-dichloro-1,3,5-triazin-2-yl)oxime as pale yellow needles having a melting point of 124°C-124.5°C. Elemental analysis of the product indicated the following:

| | |
|-------------|-----------------------------|
| Analysis: | $C_{10}H_4Cl_4N_4O$ |
| Calculated: | C, 35.54; H, 1.19; N, 16.58 |
| Found: | C, 35.72; H, 1.35; N, 16.74 |

This compound is referred to hereinafter as Compound 96.

Example XXXV

Preparation of acetophenone O-(4,6-
dichloro-1,3,5-triazin-2-yl)oxime

Acetophenone oxime and cyanuric chloride were reacted according to the procedure of Example XXXIV to give acetophenone O-(4,6-dichloro-1,3,5-triazin-2-yl)oxime having a melting point of

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123°C-125°C. Elemental analysis of the product indicated the following:

Analysis: $C_{11}H_8Cl_2N_4O$
Calculated: C, 46.67; H, 2.85; N, 19.79
Found: C, 47.10; H, 2.80; N, 19.77

The compound is referred to hereinafter as Compound 97.

Example XXXVI

Preparation of 2,6-dichlorobenzaldehyde
O-(4,6-dichloro-1,3,5-triazin-2-yl)oxime

Into 300 milliliters of ice cold acetone was added 18.9 grams (0.1 mole) of 2,6-dichlorobenzaldoxime and 18.4 grams (0.1 mole) of cyanuric chloride. The pH value of the resulting solution was maintained at 6 by addition of 5% sodium bicarbonate solution. After stirring for 3 hours and keeping the pH at 6, crystals precipitated and were collected by suction filtration, washed three times with 100 milliliters of 20% aqueous acetone and dried in a vacuum oven for about 18 hours at 60°C to give 4.92 grams (0.02 mole) of 2,6-dichloro-benzaldehyde O-(4,6-dichloro-1,3,5-triazin-2-yl)oxime having a melting point of 134.9°C-135.9°C. Elemental analysis of the product indicated the following:

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Analysis: $C_{10}H_4Cl_4N_4O$
Calculated: C, 35.54; H, 1.19; N, 16.58
Found: C, 35.78; H, 1.04; N, 16.40

This compound is referred to hereinafter as Compound 98.

Example XXXVII

Preparation of N-(2,4-dichlorophenyl)-N'-(4,6-dichloro-1,3,5-triazin-2-yl)hydrazine

A 4.3 gram (0.02 mole) portion of 2,4-dichlorophenylhydrazine was treated with 5.64 grams (0.03 mole) of cyanuric chloride in the presence of 3.11 grams (0.03 mole) of 2,6-lutidine in 125 milliliters of CH_2Cl_2 in a manner similar to that employed in Example XXXII. After stirring for about 18 hours at room temperature, the reaction mixture was concentrated under reduced pressure and the residue recrystallized from $CHCl_3$ to give 3.4 grams (0.01 mole) of N-(2,4-dichlorophenyl)-N'-(4,6-dichloro-1,3,5-triazin-2-yl) hydrazine as colorless needles having a melting point of 185.0°C-192.0°C (dec.). Elemental analysis of the product indicated the following:

Analysis: $C_9H_5Cl_4N_5$
Calculated: C, 33.26; H, 1.55; N, 21.55
Found: C, 32.88; H, 1.60; N, 20.74

This compound is referred to hereinafter as Compound 99.

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Example XXXVIII

Preparation of N-(2,4-dichlorophenyl)
-N-(4,6-dichloro-1,3,5-triazin-2-yl)
methanesulfonamide

Part A. Preparation of 2,4-dichlorophenyl (methane-
sulfonamide)

Into a magnetically stirred solution containing 13.5 grams (0.08 mole) of 2,4-dichloro-aniline, 10.1 grams (0.1 mole) of triethylamine and 80 milliliters of dry tetrahydrofuran was added dropwise a solution containing 11.5 grams (0.1 mole) of methanesulfonyl chloride in 10 milliliters of tetrahydrofuran. A white precipitate separated as the addition proceeded. Stirring at room temperature was continued for about 16 hours and the mixture was then heated to reflux for 4 hours. The product was isolated by cooling, filtering to remove the precipitate and concentrating under reduced pressure to give 21.6 grams of a yellow solid. Chromatography on silica gel using a 9:1 toluene-ethyl acetate eluent furnished 1.5 grams (0.006 mole) of 2,4-dichlorophenyl (methanesulfonamide) as a yellowish solid. NMR analysis of the product indicated the following:

NMR (CDCl₃) δ 3.10 (3H,s), 7.0 (1H,bs), 7.37 (1H,dd,J:2.9 Hz), 7.55 (1H,d,J:2Hz), 7.71 (1H,d,J:9Hz) ppm.

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Part B. Preparation of N-(2,4-dichlorophenyl)-N-(4,6-dichloro-1,3,5-triazin-2-yl) methanesulfonamide

Using a procedure similar to that employed in Example XXXVII, 1.15 grams (0.006 mole) of cyanuric chloride was treated with 1.5 grams (0.006 mole) of 2,4-dichlorophenylmethanesulfonamide and 670 milligrams (0.006 mole) of 2,6-lutidine. A colorless precipitate was separated by filtration and the filtrate was concentrated under reduced pressure to yield 2.8 grams of a yellow solid. This was flash chromatographed on silica gel employing a 3:1 hexane-ethyl acetate eluent to give 1.6 grams of a yellow solid. Recrystallization from toluene-hexane furnished 1.0 gram (0.003 mole) of N-(2,4-dichlorophenyl)-N-(4,6-dichloro-1,3,5-triazin-2-yl)methanesulfonamide as a yellow solid having a melting point of 145°C-157°C. 200 milligrams of additional yellow needles were obtained having a melting point of 154.5°C-157°C. NMR analysis of the product indicated the following:

NMR (CDCl₃): δ 3.74 (3H,s), 7.10-7.68 (3H,m) ppm.

IR (CHCl₃) 1540, 1590 cm⁻¹

¹³C NMR (CDCl₃) δ 171.60, 165.42, 136.98, 134.00, 133.08, 130.97, 130.51, 128.64, 43.50 ppm.

This compound is referred to hereinafter as Compound 100.

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Example XXXIXPreparation of 2-benzyloxy-4,6-dichloro-1,3,5-triazine

Into a magnetically stirred solution containing 4.22 grams (0.04 mole) of benzyl alcohol in 15 milliliters of acetone cooled to a temperature of 0-5°C was added dropwise 4.18 grams (0.04 mole) of 2,6-lutidine followed by a solution containing 7.2 grams (0.04 mole) of cyanuric chloride in 185 milliliters of acetone. After completing the feed, the reaction mixture was stirred for about 1 hour at 0°C and then warmed to room temperature. On reaching about 20°C, a precipitate of lutidine hydrochloride separated and was filtered off. The filtrate was poured onto ice causing the crude product to precipitate. This crude product was water-washed and dried to give 5.79 grams of material. Two recrystallizations from hexane gave 0.41 gram (0.002 mole) of 2-benzyloxy-4,6-dichloro-1,3,5-triazine having a melting point of 78°C-81.5°C. NMR analysis of the product indicated the following: NMR (CDCl₃): δ 5.55 ppm (2H, s, CH₂), 7.46 (5H, s, aromatic). This compound is referred to hereinafter as Compound 101.

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Example XLPreparation of 2-(2',4'-dichlorobenzyl)
-4,6-dichloro-1,3,5-triazine

A 1.2 gram (0.05 mole) portion of magnesium turnings and 20 milliliters of ether were placed in a 100 milliliter 3-necked round-bottom flask under a nitrogen atmosphere. Two drops of a solution containing 9.7 grams (0.05 moles) of 2,4-dichlorobenzyl chloride in 15 milliliters of ether were added to initiate the reaction. The remaining portion of this solution was then added rapidly as to cause vigorous refluxing.

The Grignard reagent-prepared above was added dropwise to a mixture of 9.2 grams (0.05 moles) of cyanuric chloride and 125 milliliters of ether cooled to a temperature of 3°C. An exotherm to 7°C and the formation of a white precipitate were observed as the addition proceeded. Stirring was continued at room temperature for about 16 hours and the resulting heterogeneous mixture was filtered to remove the magnesium salt. The filtrate was washed with water and the organic phase dried over MgSO_4 and concentrated under reduced pressure to give 12.6 grams of a yellow solid. A 4.0 gram portion of this material was chromatographed on silica gel using a 9:1 hexane: EtOAc eluent furnishing 2.9 grams of product. Recrystallization from hexane provided 1.7 grams (0.005 mole) of 2-(2',4'-dichlorobenzyl)-4,6-dichloro-1,3,5-triazine as colorless needles having a melting point of 110°C-112.5°C. Elemental analysis of this product indicated the following:

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Analysis: $C_{10}H_5Cl_4N_3$
Calculated: C, 38.87; H, 1.63; N, 13.60
Found: C, 38.71; H, 1.70; N, 13.51

This compound is referred to hereinafter as Compound 102.

Example XLI

Preparation of 2-(2',4'-dichlorophenyl)
-4,6-dichloro-1,3,5-triazine

A Grignard reagent was prepared from 11.1 grams (0.04 mole) of 2,4-dichloriodobenzene in the same manner as described in Example XL. The reagent was added dropwise to a solution of 7.5 grams (0.04 mole) of cyanuric chloride in 75 milliliters of dry tetrahydrofuran cooled to a temperature of 3°C. This caused an exotherm to 8°C and the formation of a white solid. The reaction mixture was stirred at room temperature for 7 hours and then heated to reflux for 3 days. The solid was separated by filtration and a black filtrate was concentrated under reduced pressure. The residue was partitioned between EtOAc and water and the organic phase dried over $MgSO_4$ and concentrated to yield 14.9 grams of a black solid. Most of the unreacted cyanuric chloride was distilled out using a Kugelrohr apparatus. The residue was then chromatographed on silica gel using a 9:1 hexane: EtOAc eluent. This furnished 5.4 grams of a crude material. Sublimation (.05 mm Hg, 80°C-85°C) provided 2.0

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grams (0.007 mole) of 2-(2',4'-dichloro-phenyl)-4,6-dichloro-1,3,5-triazine as a colorless solid having a melting point of 111°C-115°C. Elemental analysis of the product indicated the following:

| | |
|-------------|-----------------------------|
| Analysis: | $C_9H_3Cl_4N_3$ |
| Calculated: | C, 36.65; H, 1.03; N, 14.25 |
| Found: | C, 34.22, H, 0.92; N, 13.20 |

This compound is referred to hereinafter as Compound 103.

Example XLII

Preparation of 2,4-dichloro-6-phenyl-1,3,5-triazine

A 1.40 gram portion (0.06 mole) of clean magnesium turnings was suspended in 4 milliliters of ethyl ether under a dry nitrogen atmosphere in a 50 milliliter reaction flask equipped with an additional funnel. Bromobenzene (9.48 grams, 0.06 mole) and approximately 21 milliliters of ether were charged to the flask's addition funnel and about 2 milliliters of this solution was added into the flask which was warmed to initiate the reaction. The remaining bromobenzene solution was added over about a one hour period giving a controlled rate of reflux. The mixture was stirred at room temperature for about 16 hours and then heated under reflux.

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The Grignard reagent prepared above was then transferred by syringe to a dry addition funnel attached to a stirred, nitrogen-purged dry flask containing a solution of 8.15 grams (0.04 mole) of cyanuric chloride in 75 milliliters benzene which was cooled to a temperature of 3°C. The Grignard reagent solution was fed dropwise with stirring and the resulting mixture allowed to warm to room temperature for a 4-day period. The reaction mixture was quenched with 50 milliliters of water and extracted with ether after which the organic layers were dried and evaporated free of solvent to give a solid. Crystallization from hexane gave a 4.91 gram (0.02 mole) first crop of product which was recrystallized from cyclohexane and then vacuum sublimed to give 2,4-dichloro-6-phenyl-1,3,5-triazine as a white crystalline material having a melting point of 117°C-118°C. Elemental analysis of the product indicated the following:

| | |
|-------------|-----------------------------|
| Analysis: | $C_9H_5Cl_2N_3$ |
| Calculated: | C, 47.80; H, 2.23; N, 18.58 |
| Found: | C, 47.50; H, 2.26; N, 18.49 |

This compound is referred to hereinafter as Compound 104.

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Example XLIIIPreparation of 2-(1-naphthyl)-
4,6-dichloro-1,3,5-triazine

Into 0.66 gram (0.03 mole) of magnesium turnings was added a solution containing 3.77 milliliters (0.03 mole) of 1-bromonaphthalene in 50 milliliters of dry tetrahydrofuran. The resulting mixture was stirred at room temperature for 20 minutes, 150 milliliters of dry tetrahydrofuran was added and the mixture then stirred at room temperature under a nitrogen atmosphere for a period of 1 hour.

The Grignard reagent prepared above was transferred to an addition funnel and added dropwise to a solution containing 5.0 grams (0.03 mole) of cyanuric chloride in 300 milliliters of dry tetrahydrofuran at room temperature. After this mixture was stirred for a period of 3 hours, the solvent was evaporated to give a solid residue which was partitioned between 10% aqueous NaOH solution and Et₂O. The Et₂O layer was stirred over anhydrous Na₂SO₄ and evaporated and the residue purified by preparative plate chromatography (silica gel) using 20% EtOAc in hexane to give 160 milligrams (0.0006 mole) of 2-(1-naphthyl)-4,6-dichloro-1,3,5-triazine as a yellow solid having a melting point of 166°C-167°C. Elemental analysis of the product indicated the following:

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Analysis: $C_{13}H_7Cl_2N_3$
Calculated: C, 56.54; H, 2.56;
Found: C, 55.27; H, 2.62

This compound is referred to hereinafter as Compound 105.

Example XLIV

Preparation of 2-(2-naphthyl)-
4,6-dichloro-1,3,5-triazine

In a manner similar to that employed in Example XLIII except that ethyl ether was used as the solvent in place of tetrahydrofuran and the Grignard reagent was prepared from 2-bromonaphthalene in refluxing ether over a 1.5 hour period. 2-(2-naphthyl)-4,6-dichloro-1,3,5-triazine was prepared having a melting point of 193°C-194°C. Elemental analysis of the product indicated the following:

Analysis: $C_{13}H_7Cl_2N_3$
Calculated: C, 56.54; H, 2.56; N, 15.22;
Cl, 25.68
Found: C, 54.48; H, 2.63; N, 14.54;
Cl, 27.98

This compound is referred to hereinafter as Compound 106.

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Example XLVPreparation of 2-benzyl-4,6-dichloro-1,3,5-triazine

A Grignard reagent prepared from 1.40 grams (0.06 mole) of magnesium and 0.91 gram (0.09 mole) of benzyl chloride was reacted with 8.15 grams (0.04 mole) of cyanuric chloride in a manner similar to that employed in Example XLII. The crude product (2.70 grams) was vacuum sublimed and then resublimed to give 0.99 gram (0.004 mole) of pure 2-benzyl-4,6-dichloro-1,3,5-triazine having a melting point of 82°C-85°C. Elemental analysis of the product indicated the following:

Analysis: $C_{10}H_7Cl_2N_3$
Calculated: C, 50.02; H, 2.94; N, 17.49
Found: C, 49.90; H, 2.85; N, 17.57

The compound is referred to hereinafter as Compound 107.

Example XLVIPreparation of 2-(2',4'-dichlorobenzylthio)-4,6-dichloro-1,3,5-triazinePart A. Preparation of 2,4-dichlorobenzyl mercaptan

A mixture of 4.8 grams (0.06 mole) of thiourea, 12.2 grams (0.06 mole) of 2,4-dichlorobenzyl chloride and 50 milliliters of ethanol was stirred and heated to reflux under a nitrogen

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atmosphere for 4 1/2 hours. The reaction mixture was then cooled and a solution of 6.25 grams (0.16 mole) of NaOH in 50 milliliters of water was added dropwise. After the addition was completed, the mixture was heated to reflux for 2 hours during which time it became yellow in color. Stirring at room temperature was continued for 2 days. The ethanol was then removed under reduced pressure and the aqueous residue was extracted with CH_2Cl_2 (6 x 100 milliliters). The combined organic layers were dried over MgSO_4 and concentrated to yield 12.1 grams (0.06 mole) of 2,4-dichlorobenzyl mercaptan as a tan colored liquid. NMR analysis of the product indicated the following: NMR (CDCl_3): δ 1.90 (1H, t, J=8Hz), 3.79 (2H, d, J=8Hz), 7.18-7.33 (2H, m), 7.33-7.48 (1H, m) ppm.

Part B. Preparation of 2-(2',4'-dichlorobenzylthio)-4,6-dichloro-1,3,5-triazine

Into a solution containing 6.5 grams (0.03 mole) of cyanuric chloride in acetone was added 6.7 grams (0.03 mole) of 2,4-dichlorobenzyl mercaptan prepared in Part A. A procedure similar to that employed in Example XXXII was used to prepare the product. The crude product was chromatographed on silica gel using a 1:1 hexane-toluene eluent to furnish 2.0 grams of the pure product. Recrystallization provided 1.9 grams (0.006 mole) of 2-(2',4'-dichlorobenzylthio)-4,6-dichloro-1,3,5-triazine having a melting point of 55.5°C-58.5°C. Elemental analysis of the product indicated the following:

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Analysis: $C_{10}H_5Cl_4N_3S$
Calculated: C, 35.22; H, 1.48; N, 12.32
Found: C, 35.56; H, 1.62; N, 12.47

This compound is referred to hereinafter as Compound 108.

Example XLVII

Preparation of 6-chloro-2,4-bis-
(2',4'-dichlorobenzylthio)-1,3,5-triazine

The early chromatographic fractions from Example XLVI contained 2.3 grams of a colorless solid which was recrystallized from hexane to give 2.2 grams (0.004 mole) of 2,4-bis-(2',4'-dichlorobenzylthio)-6-chloro-1,3,5-triazine having a melting point of 76.0°C-80.0°C. Elemental analysis of the product indicated the following:

Analysis: $C_{17}H_{10}Cl_5N_3S_2$
Calculated: C, 41.03; H, 2.03; N, 8.44
Found: C, 41.35; H, 2.25; N, 8.93

This compound is referred to hereinafter as Compound 109.

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Example XLVIIIPreparation of 2-(2',4'-dichlorophenethoxy)-
4,6-dichloro-1,3,5-triazinePart A. Preparation of 2,4-dichlorophenethyl alcohol

A 124 milliliter portion of a 1 M solution of borane-tetrahydrofuran complex in tetrahydrofuran was placed in a 500 milliliter 3-necked round-bottom flask and cooled to a temperature of 0°C with an ice bath. A solution containing 12.7 grams (0.06 mole) of 2,4-dichlorophenylacetic acid in 100 milliliters of tetrahydrofuran was added dropwise at such a rate as to maintain the temperature below 5°C. Gas evolution was observed as the addition proceeded. After the addition was completed, the colorless mixture was heated to reflux for 1 hour and then stirred at room temperature for about 16 hours. The reaction mixture was then treated with 125 milliliters of methanol. The solvent was removed under reduced pressure and the residue was dissolved in ether and washed with 5% aqueous NaOH. The organic phase was dried over MgSO_4 and concentrated to yield 12.7 grams (0.066 mole) of 2,4-dichlorophenethyl alcohol as a colorless oil. NMR analysis of the product indicated the following: NMR (CDCl_3): δ 1.62 (1H, s), 2.98 (2H, t, $J=7\text{Hz}$), 3.88 (2H, t, $J=7\text{Hz}$), 7.10-7.48 (3H, m) ppm.

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Part B. Preparation of 2-(2',4'-dichlorophenethoxy)-
4,6-dichloro-1,3,5-triazine

A solution containing 6.45 grams (0.04 mole) of cyanuric chloride in acetone was treated with 6.7 grams (0.04 mole) of 2,4-dichlorophenethyl alcohol prepared in Part A using a procedure similar to that employed in Example XXXII. The crude product was chromatographed on silica gel using a 1:1 toluene-hexane eluent. The material obtained was recrystallized from hexane to yield 2.2 grams (0.006 mole) of 2-(2',4'-dichlorophenethoxy)-4,6-dichloro-1,3,5-triazine as colorless needles having a melting point of 106.5°C-108°C. Elemental analysis of the product indicated the following:

Analysis: $C_{11}H_7Cl_4N_3O$
Calculated: C; 38.97; H, 2.08; N, 12.40
Found: C, 39.14; H, 2.35; N, 12.54

This compound is referred to hereinafter as Compound 110.

Example XLIX

Preparation of N-(4,6-dichloro-1,3,5-
triazin-2-yl)-2,4-dichlorobenzamide

Into a stirred mixture containing 2.2 grams (0.01 mole) of 2,4-dichlorobenzoyl chloride, 1.7 grams (0.01 mole) of 2-amino-4,6-dichlorotriazine and 80 milliliters of acetone cooled to a temperature of 0°C was added a solution containing

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400 milligrams of NaOH in 4 milliliters of water. The NaOH solution was added at such a rate as to maintain the temperature below 4°C. Stirring was continued for a period of 3 hours after the addition was complete. The reaction mixture was then poured onto ice and the resulting milky solution was extracted with dichloromethane (4 x 75 milliliters). The combined extracts were dried over MgSO_4 and concentrated under reduced pressure to give 3.6 grams of a colorless solid. Flash chromatography using a 9:1 hexane-EtOAc eluent furnished 900 milligrams of a colorless solid. This material was then dissolved in CH_2Cl_2 and washed with saturated aqueous NaHCO_3 . The organic layer was dried over MgSO_4 and concentrated on the rotovap. The residue was recrystallized from toluene-hexane to yield 300 milligrams (0.001 mole) of N-(4,6-dichloro-1,3,5-triazin-2-yl)-2,4-dichlorobenzamide having a melting point of 162°C-166°C. Elemental analysis of the product indicated the following:

| | |
|-------------|--|
| Analysis: | $\text{C}_{10}\text{H}_4\text{Cl}_4\text{N}_4\text{O}$ |
| Calculated: | C, 35.54; H, 1.19; N, 16.58 |
| Found: | C, 36.03; H, 1.54; N, 16.23 |

This compound is referred to hereinafter as Compound 111.

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Example LPreparation of N-(4,6-dichloro-1,3,5-triazin-2-yl)
-2,4-dichloroacetanilidePart A. Preparation of 2,4-dichloroacetanilide

Into a 100 milliliter 3-necked round bottom flask was added 20 milliliters (0.21 mole) of acetic anhydride under a nitrogen atmosphere and cooled to a temperature of 3°C with an ice bath. To this was added 13.5 grams (0.08 mole) of 2,4-dichloroaniline in small portions. The mixture was allowed to stir at room temperature for 17 hours. The colorless solid which formed was removed by filtration and dried in the vacuum oven to yield 16.5 grams (0.08 mole) of 2,4-dichloroacetanilide. NMR analysis of the product indicated the following: NMR (CDCl₃): δ 2.22 (3H,s), 7.18 (1H, dd), 7.34 (1H,d), 7.40-7.78 (1H,bs), 8.28 (1H,d) ppm.

Part B. Preparation of N-(4,6-dichloro-1,3,5-triazin
-2-yl)-2,4-dichloroacetanilide

Using a procedure similar to that employed in Example XLIX, a mixture containing 6.0 grams (0.03 mole) of 2,4-dichloroacetanilide prepared in Part A, 5.5 grams (0.03 mole) of cyanuric chloride and 120 milliliters of acetone was treated with a solution containing 1.18 grams (0.03 mole) of NaOH in 12 milliliters of water. Work-up furnished 10.5 grams of a colorless oil which was chromatographed on silica gel using a 9:1 hexane-ethyl acetate eluent. This gave 8.0 grams of a yellowish oil

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which solidified on standing. Recrystallization from hexane furnished 6.4 grams (0.02 mole) of colorless prisms of N-(4,6-dichloro-1,3,5-triazin-2-yl)-2,4-dichloroacetanilide having a melting point of 106°C-108.5°C. NMR analysis of the product indicated the following: NMR (CDCl₃): δ 2.82 (3H,s), 7.18 (1H,d,J=9Hz), 7.45 (1H,dd,J=2.9Hz), 7.6 (1H,d,J=2Hz) ppm.

This product is referred to hereinafter as Compound 112.

Example LI

Preparation of 2,4,-dichloro-6-phenylethynyl -1,3,5-triazine

Into ethylmagnesium bromide (49 milliliters of a 2 M solution in tetrahydrofuran, 0.1 mole) was added phenylacetylene (10 grams, 0.1 mole) in tetrahydrofuran (50 milliliters). Cyanuric chloride (12 grams, 0.07 mole) in benzene (65 milliliters) was added dropwise maintaining the reaction temperature below 25°C. After six hours of stirring the solvent was evaporated and the residue extracted with ether. The solvent was evaporated and the residue triturated with ether to afford 1.5 grams (0.006 mole) of 2,4-dichloro-6-phenylethynyl -1,3,5-triazine as a yellow solid having a melting point of 125°C-131°C. Elemental analysis of the product indicated the following:

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Analysis: $C_{11}H_5ClN_3$
Calculated: C, 52.83; H, 2.02; N, 16.80
Found: C, 53.37; H, 2.28; N, 16.25

This compound is referred to hereinafter as Compound 113.

Example LII

Preparation of 2-chloro-4-(phenylethynyl)-6-(2',2',2'-trifluoroethoxy)-1,3,5-triazine and 2,4-bis-(2',2',2'-trifluoroethoxy)-6-(phenylethynyl)-1,3,5-triazine

In a manner similar to that employed in Examples XXVIII and XXIX, 2, 4-dichloro-6-phenylethynyl-1,3,5-triazine was reacted with 2,2,2-trifluoroethanol to give 2-chloro-4-(phenylethynyl)-6-(2',2',2'-trifluoroethoxy)-1,3,5-triazine having a melting point of 48°C-51°C and also 2,4-bis-(2',2',2'-trifluoroethoxy)-6-(phenylethynyl)-1,3,5-triazine having a melting point of 68°C-72°C. Elemental analysis of the two products indicated the following:

2-chloro-4-(phenylethynyl)-6-(2',2',2'-trifluoroethoxy)-1,3,5-triazine

Analysis: $C_{13}H_7ClF_3N_3O$
Calculated: C, 49.78; H, 2.25; F, 18.17;
Found: C, 50.98; H, 2.42; F, 17.11

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This compound is referred to hereinafter as Compound 114.

2,4-bis-(2',2',2'-trifluoroethoxy)-6-(phenylethynyl)
-1,3,5-triazine

Analysis: $C_{15}H_9F_6N_3O_2$
Calculated: C, 47.76; H, 2.40; N, 11.14;
F, 30.22
Found: C, 48.42; H, 2.32; N, 11.26;
F, 29.33

This compound is referred to hereinafter as Compound 115.

Example LIII

Preparation of 2-[4-(phenylazo)phenoxy]-4,
6-dichloro-1,3,5-triazine

Into a 250 milliliter 3-neck round bottom flask equipped with a thermometer, addition funnel and nitrogen inlet was added cyanuric chloride (4.67 grams, 0.03 mole) dissolved in 30 milliliters of acetone and cooled to a temperature of 0-5°C in an ice bath. The addition funnel was charged with a solution containing 4-phenylazophenol (5.0 grams, 0.03 mole) and 2,6-lutidine (2.91 milliliters, 0.03 mole) in 30 milliliters of acetone, and this mixture was added dropwise maintaining the reaction temperature between 0°C and 5°C. After the addition was complete, the reaction was stirred at room

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temperature for 16 hours, filtered through a Celite pad, and ice-water (140 milliliters) was added. The precipitate which formed was collected on a Buchner funnel. The precipitate was dissolved in EtOAc, washed with saturated NaHCO_3 and water, dried (MgSO_4) and concentrated. The crude product was recrystallized twice from hexane: CHCl_3 (2:1), to give 750 milligrams (0.002 mole) of 2-[4-(phenylazo)phenoxy]-4,6-dichloro-1,3,5-triazine having a melting point of 162.0°C - 164.0°C . Elemental analysis of the product indicated the following:

Analysis: $\text{C}_{15}\text{H}_9\text{Cl}_2\text{N}_5\text{O}$
Calculated: C, 52.04; H, 2.62; N, 20.23
Found: C, 52.37; H, 2.82; N, 20.20

This compound is referred hereinafter as Compound 116.

Example LIV

Preparation of 2,2'-[1,3-phenylenebis(oxy)]-bis[4,6-dichloro-1,3,5-triazine]

Into a 250 milliliter 3-neck round bottom flask equipped with a nitrogen inlet, thermometer, and addition funnel was added cyanuric chloride (13.46 grams, 0.07 mole) dissolved in 100 milliliters of acetone and cooled to a temperature of $0-5^\circ\text{C}$ in an ice bath. Resorcinol (4.0 grams, 0.04 mole) and 2,6-lutidine (8.50 milliliters, 0.07 mole) dissolved in 100 milliliters of acetone were placed

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in the addition funnel. This solution was slowly added dropwise while maintaining the reaction temperature at 0-5°C. The reaction was then stirred at room temperature for 16 hours. At this time the precipitate was removed by filtration through a Celite pad. Addition of ice-water (140 milliliters) to the filtrate gave an oil which was extracted from the aqueous solution with EtOAc (2 x 150 milliliters). The combined organic layers were dried (MgSO_4) and concentrated in vacuo. The crude product was purified by flash chromatography on silica (eluent 5% EtOAc/hexane) to give 2.80 grams (0.007 mole) of the 2,2'-[1,3-phenylenebis(oxy)]-bis[4,6 dichloro-1,3,5-triazine] as a white solid having a melting point of 145°C-148°C. Elemental analysis of the product indicated the following:

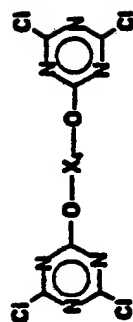
| | |
|-------------|--|
| Analysis: | $\text{C}_{12}\text{H}_4\text{Cl}_4\text{N}_6\text{O}_2$ |
| Calculated: | C, 35.50; H, 0.99; N, 20.70 |
| Found: | C, 35.07; H, 0.91; N, 20.40 |


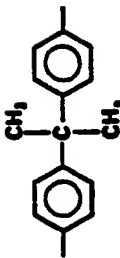
This compound is referred to hereinafter as Compound 117.

Example LV

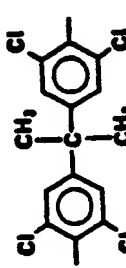

In a manner similar to that employed in Example LIV, other compounds were prepared. The structures and analytical data for Compounds 118 through 121, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table F below.

TABLE I
Representative Heterocyclic Nitrogen - Containing Compounds



| Compound No. | Substituents | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|--|--------------------|------|-------|-------|------|-------|--------------------|
| | | Calculated | | | Found | | | |
| | | C | H | N | C | H | N | |
| 118 |  | 35.50 | 0.99 | 20.70 | 36.04 | 1.19 | 19.94 | 253.0-257.0 |
| 119 |  | 48.11 | 2.69 | 16.03 | 48.06 | 2.67 | 15.92 | 115.0-116.0 |

Clc1cc(Cl)cc(Cl)c1Oc2cc(Cl)cc(Cl)c2

| Compound No. | Substituent | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|---|--------------------|------|-------|------|-------|-------------|--------------------|
| | | Calculated | | Found | | | | |
| | X ₄ | C | H | C | H | | | |
| 120 |  | 38.10 | 1.52 | 38.04 | 1.69 | 12.31 | 228.0-232.0 | |
| 121 |  | 42.05 | 1.57 | 42.26 | 2.00 | 16.65 | 161.0-163.0 | |

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Example LVIPreparation of bis-
(4,6-dichloro-1,3,5-triazin-2-yl)amine

Into a 250 milliliter 3-neck round bottom flask equipped with a thermometer and addition funnel was added cyanuric chloride (2.78 grams, 0.02 mole) in 50 milliliters of acetone cooled to a temperature of 0-5°C. 2-Amino-4,6-dichloro-1,3,5-triazine (2.48 grams, 0.02 mole) was added and the reaction temperature was brought to 0-5°C. A cold solution of NaOH (0.6 gram, 0.02 mole) in 6 milliliters of water was slowly added dropwise over 20 minutes. The reaction mixture was then stirred at room temperature for 4 hours, and then poured into 250 milliliters of ice-water with 4.5 grams of Na_2CO_3 dissolved in it. The solution was filtered to remove a solid precipitate (tris[4,6-dichloro-1,3,5-triazin-2-yl]amine) and the filtrate was acidified. A white precipitate was collected on a Buchner funnel. The resulting powdery crystals (1.51 grams) were sublimed over a 2 day period to give 0.97 gram (0.003 mole) of pure bis(4,6-dichloro-1,3,5-triazin-2-yl)amine having a melting point of 204.0°C-207.0°C. Elemental analysis of the product indicated the following:

| | |
|-------------|------------------------------------|
| Analysis: | $\text{C}_6\text{HCl}_4\text{N}_6$ |
| Calculated: | C, 23.03; H, 0.32; N, 31.33 |
| Found: | C, 22.67; H, 1.20; N, 30.67 |

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This compound is referred to hereinafter as Compound 122.

Example LVII

Preparation of N,N-bis(4,6-dichloro-1,3,5-triazin-2-yl)-4'-fluorobenzenamine

N,N-bis(4,6-dichloro-1,3,5-triazin-2-yl)-4'-fluorobenzenamine was obtained from Maybridge Chemical Company, Limited, Trevillet, Tintagel, Cornwall, United Kingdom, and recrystallized from toluene. The melting point was determined to be 231.0°C-233.0°C. Elemental analysis of the compound indicated the following:

| | |
|-------------|-----------------------------|
| Analysis: | $C_{12}H_4Cl_4FN_7$ |
| Calculated: | C, 35.41; H, 0.99; N, 24.08 |
| Found: | C, 34.41; H, 1.06; N, 23.82 |

This compound is referred to hereinafter as Compound 123.

Example LVIII

Preparation of N,N-bis(4,6-dichloro-1,3,5-triazin-2-yl)-3'-chloro-4'-fluorobenzenamine

N,N-bis(4,6-dichloro-1,3,5-triazin-2-yl)-3'-chloro-4'-fluorobenzenamine was obtained from Maybridge Chemical Company, Limited, Trevillet,

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Tintagel, Cornwall, United Kingdom, and recrystallized from toluene. The melting point was determined to be 228.5°C-229.5°C. Elemental analysis of the compound indicated the following:

| | |
|-------------|-----------------------------|
| Analysis: | $C_{12}H_3Cl_5FN_7$ |
| Calculated: | C, 32.65; H, 0.68; N, 22.21 |
| Found: | C, 32.21; H, 0.86; N, 21.65 |

This compound is referred to hereinafter as Compound 124.

Example LIX

Preparation of 2,2',4,4'-tetrachlorohydrazo- 1,3,5-triazine

Into a 100 milliliter 3-neck round bottom flask equipped with a mechanical stirrer, thermometer, addition funnel and nitrogen inlet was added cyanuric chloride (3.68 grams, 0.02 mole) in 20 milliliters of tetrahydrofuran which was stirred vigorously and cooled to a temperature of -15°C to -10°C. Hydrazine hydrate (1.90 grams, 55% hydrazine content, 0.03 mole) in 4 milliliters of water was slowly added via the addition funnel, maintaining the reaction temperature between -15°C to -10°C. After the addition was complete, the reaction was stirred at 0°C for 15 minutes. Ice-water (40 milliliters) was added and the aqueous solution was then extracted with EtOAc (2 x 100 milliliters) and

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the extracts dried (MgSO_4) and concentrated in vacuo to give 2.92 grams (0.009 mole) of 2,2',4,4'-tetrachlorohydrazo-1,3,5-triazine as a fine white solid which started to decompose over 250°C. Elemental analysis of the product indicated the following:

Analysis: $\text{C}_6\text{H}_2\text{Cl}_4\text{N}_8$
Calculated: C, 21.97; H, 0.61; N, 34.17
Found: C, 23.64; H, 1.34; N, 36.23

This compound is referred to hereinafter as Compound 125.

Example LX

Preparation of 2,2',4,4'-tetrachloroazo-1,3,5-triazine

Into a 250 milliliter 3-neck round bottom flask equipped with a septum, outlet to acid trap and stopper was added 2,2',4,4'-tetrachlorohydrazo-1,3,5-triazine (3.20 grams, 0.01 mole) and 100 milliliters of CHCl_3 . Sodium bicarbonate (1.64 grams, 0.02 mole) dissolved in 50 milliliters of water was added. The two phase solution was slowly stirred so that the phases remained separate. A slow stream of Cl_2 gas was then bubbled through the CHCl_3 layer until the CHCl_3 layer was homogeneous and deep red, i.e., about 75 minutes. At this time the CHCl_3 layer was separated and

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washed with water, dried (Na_2SO_4) and concentrated in vacuo to give orange crystals which were slurried in ether, cooled and filtered. The resulting pale orange solid was recrystallized from CHCl_3 to give 2.1 grams (0.006 mole) of 2,2',4,4'-tetrachloroazo-1,3,5-triazine having a melting point of 186.0°C-190.0°C. Elemental analysis of the product indicated the following:

| | |
|-------------|-----------------------------------|
| Analysis: | $\text{C}_6\text{Cl}_4\text{N}_3$ |
| Calculated: | C, 22.11; H, 0.00; N, 34.38 |
| Found: | C, 22.78; H, 0.28; N, 33.98 |

This compound is referred to hereinafter as Compound 126.

Example LXI

Preparation of 2,4-dichloro-6-(4'-formyl-2'-methoxyphenoxy)-1,3,5-triazine

Into a solution containing cyanuric chloride (5.0 grams, 0.03 mole) in acetone (140 milliliters) at 0°C was added dropwise a solution containing 2,6-lutidine (3.15 milliliters, 0.03 mole) and 4-hydroxy-3-methoxybenzaldehyde (4.125 grams, 0.03 mole) in acetone (25 milliliters) while maintaining the temperature below 5°C. After 2 hours of stirring, the reaction mixture was filtered, and the filtrate filtered through silica gel and washed with acetone to afford 650 milligrams

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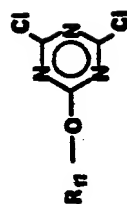
(0.002 mole) of 2,4-dichloro-6-(4'-formyl-2'-methoxyphenoxy)-1,3,5-triazine as a white solid having a melting point of 156°C-157.5°C. NMR analysis of the product indicated the following: ¹H NMR(CDCl₃): δ 3.8(s,3H); 7.2-7.7(m,3H); 10.05(s,1H) ppm.

This compound is referred to hereinafter as Compound 127.

Example LXII

In a manner similar to that employed in Example LXI, other compounds were prepared. The structures and analytical data for Compounds 128 through 131, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table G below.

TABLE 6
Representative Heterocyclic Nitrogen - Containing Compounds




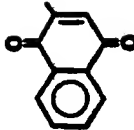
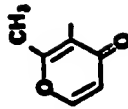
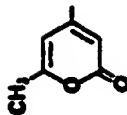
| Compound No. | Substituents | Elemental Analysis | | | | | | | Melting Point (°C) |
|--------------|--|--------------------|------|-------|-------|------|-------|---------|--------------------|
| | | Calculated | | | Found | | | | |
| | | C | H | N | C | H | N | | |
| 128 |  | 33.68 | 1.26 | 13.09 | 33.61 | 1.33 | 13.03 | 88-91 | |
| 129 |  | 48.47 | 1.56 | 13.05 | 49.58 | 1.93 | 12.49 | 152-162 | |

TABLE 8 (Cont.)
Representative Heterocyclic Nitrogen - Containing Compounds



| Compound No. | Substituents | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|--|--------------------|------|-------|-------|------|-------|--------------------|
| | | Calculated | | | Found | | | |
| | | C | H | N | C | H | N | |
| 130 |  | 39.44 | 1.84 | 15.33 | 35.36 | 1.65 | 16.78 | 126-135 |
| 131 |  | 39.44 | 1.84 | 15.33 | 39.93 | 1.91 | 14.63 | 177-180 |

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Example LXIIIPreparation of 2,4-dichloro-6-(5'-methyloxazolyl-3'-amino)-1,3,5-triazine

Into a solution containing cyanuric chloride (5.0 grams, 0.03 mole) in acetone (100 milliliters) at a temperature of 0°C was added dropwise a solution containing 2,6-lutidine (3.15 milliliters, 0.03 mole) and 3-amino-5-methyloxazole (2.66 grams, 0.03 mole) in acetone (50 milliliters) while maintaining the temperature below 5°C. After 2 hours of stirring, the reaction mixture was warmed to room temperature and then poured onto 200 milliliters of ice-water. The mixture was filtered, the solid dried and recrystallized from chloroform to afford 800 milligrams (0.003 mole) of 2,4-dichloro-6-(5'-methyloxazolyl-3'-amino)-1,3,5-triazine as a solid having a melting point of 128°C-132°C. Elemental analysis of the product indicated the following:

| | |
|-------------|-----------------------------|
| Analysis: | $C_7H_5Cl_2N_5O$ |
| Calculated: | C, 34.17; H, 2.05; N, 28.06 |
| Found: | C, 34.24; H, 2.11; N, 28.15 |

This compound is referred to hereinafter as Compound 132.

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Example LXIVPreparation of 2,4-dichloro-6-
(2-pyridinylamino)-1,3,5-triazine

Into a solution containing cyanuric chloride (18.4 grams, 0.1 mole) in acetone (140 milliliters) and crushed ice-water (200 milliliters) was added dropwise 2-aminopyridine (9.4 grams, 0.1 mole) in acetone (68 milliliters) while maintaining the reaction temperature below 5°C. Sodium hydroxide (50 milliliters of a 2N solution, 0.1 mole) was then added keeping the temperature below 5°C and the pH below 8.0. The reaction mixture was filtered and chromatographed on silica gel to afford 590 milligrams (0.002 mole) of 2,4-dichloro-6-(2-pyridinylamino)-1,3,5-triazine as an orange solid having a melting point of 170°C-172°C. Elemental analysis of the product indicated the following:

| | |
|-------------|-----------------------------|
| Analysis: | $C_8H_5Cl_2N_5$ |
| Calculated: | C, 39.69; H, 2.08; N, 28.93 |
| Found: | C, 34.08; H, 1.47; N, 27.92 |

This compound is referred to hereinafter as Compound 133.

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Example LXVPreparation of 2-benzoxazolylamino-
4,6-dichloro-1,3,5-triazine

Into a mixture containing 2-aminobenzoxazole (1.0 gram, 0.007 mole) and cyanuric chloride (1.38 grams, 0.007 mole) in acetone (12 milliliters) at a temperature of 0°C was added 5% sodium hydroxide solution (34 milliliters) at such a rate as to maintain the temperature of the reaction mixture below 10°C and to maintain the pH between 6.5 and 7.0. After the addition was completed, the reaction mixture was filtered and the solid (0.75 gram) recrystallized from chloroform to afford 100 milligrams (0.003 mole) of 2-benzoxazolylamino-4,6-dichloro-1,3,5-triazine as a white solid having a melting point greater than 250°C. Elemental analysis of the product indicated the following:

Analysis: $C_{10}H_5Cl_2N_5O$
Calculated: C, 42.58; H, 1.79; N, 24.83
Found: C, 41.68; H, 1.78; N, 23.58

This compound is referred to hereinafter as Compound 134.

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Example LXVIPreparation of 2,4-dichloro-6-(4'-quinazolinioxy)-
-1,3,5-triazine

Into a mixture containing 4-hydroxy-quinazoline (5 grams, 0.03 mole) and cyanuric chloride (6.3 grams, 0.03 mole) in acetone (110 milliliters) was added 2% sodium hydroxide solution at such a rate as to maintain the temperature of the reaction mixture below 10°C and the pH between 6.5 and 7.0. After the addition was completed, the reaction mixture was allowed to warm to room temperature and stirred for about 16 hours. The reaction mixture was filtered, the solid placed in a Soxhlet extractor and extracted with refluxing chloroform. Evaporation of the solvent and chromatography on silica gel afforded 100 milligrams (0.0003 mole) of 2,4-dichloro-6-(4'-quinazolinioxy)-1,3,5-triazine as a solid having a melting point greater than 250°C. NMR analysis of the product indicated the following:

¹H NMR (CDCl₃): δ 7.2-8.2 ppm (5H, m), 8.5 ppm (1H, s)

This compound is referred to hereinafter as Compound 135.

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Example LXVIIPreparation of 2-(2-carbazolyloxy)-
4,6-dichloro-1,3,5-triazine

Into a mixture containing 2-hydroxycarbazole (3 grams, 0.02 mole) and cyanuric chloride (3 grams, 0.02 mole) in acetone (130 milliliters) at a temperature of 0°C was added 2% sodium hydroxide solution (130 milliliters) at such a rate as to maintain the temperature of the reaction mixture below 10°C and the pH between 6.5 and 7.0. After the addition was completed, the reaction mixture was stored in the refrigerator for about 16 hours and the solid product filtered and recrystallized from acetone. The solid was placed in a Soxhlet extractor, and extracted with refluxing chloroform for about 16 hours. Evaporation of the solvent afforded 3.75 grams (0.01 mole) of 2-(2-carbazolyloxy)-4,6-dichloro-1,3,5-triazine as a solid having a melting point of 249°C-256°C. Elemental analysis of the product indicated the following:

Analysis: $C_{15}H_8Cl_2N_4O$
Calculated: C, 54.40; H, 2.44; N, 16.92
Found: C, 53.38; H, 2.51; N, 16.50

This compound is referred to hereinafter as Compound 136.

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Example LXVIIIPreparation of 2,4-dichloro-6-[4-(2,3-dimethyl-1-phenyl-3-pyrazolin-5-one-amino)]-1,3,5-triazine

Into a solution containing cyanuric chloride (18.4 grams, 0.1 mole) in acetone (200 milliliters) and crushed ice-water (200 milliliters) was added dropwise 4-aminoantipyrine (20.3 grams, 0.1 mole) in acetone (180 milliliters) while maintaining the reaction temperature below 5°C. Sodium hydroxide (50 milliliters of a 2N solution, 0.1 mole) was then added keeping the temperature below 5°C, and the pH below 8.0. The reaction mixture was filtered, the filtrate evaporated to remove acetone and the residue continuously extracted with ether for a period of about 16 hours. The solvent was evaporated to afford 860 milligrams (0.003 mole) of 2,4-dichloro-6-[4-(2,3-dimethyl-1-phenyl-3-pyrazolin-5-one-amino)]-1,3,5-triazine as a white solid having a melting point greater than 250°C. Elemental analysis of the product indicated the following:

| | |
|-------------|-----------------------------|
| Analysis: | $C_{14}H_{12}Cl_2N_2O$ |
| Calculated: | C, 47.88; H, 3.45; N, 23.93 |
| Found: | C, 46.57; H, 3.49; N, 23.05 |

This compound is referred to hereinafter as Compound 137.

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Example LXIXPreparation of 4,6-dichloro-2-
(N-phthalimido)-1,3,5-triazine

Into a solution containing 20.8 grams (0.1 mole) of cyanuric chloride in 100 milliliters of acetone was added a suspension of 20.8 grams (0.1 mole) of potassium phthalimide in 200 milliliters of acetone with cooling to a temperature of 0-4°C. The resulting mixture was stirred at 0-4°C for 3 hours and then stirred at room temperature for about 16 hours. The mixture was filtered and the filtrate poured into ice-water with trituration to effect precipitation. The mixture was filtered and the solid dried in vacuo to give 17 grams of crude product. This crude product was recrystallized from CH_2Cl_2 -hexane to give 4.5 grams (0.02 mole) of 4,6-dichloro-2-(N-phthalimido)-1,3,5-triazine having a melting point of 176°C-177°C Elemental analysis of the product indicated the following:

| | |
|-------------|--|
| Analysis: | $\text{C}_{11}\text{H}_4\text{Cl}_2\text{N}_4\text{O}_2$ |
| Calculated: | C, 44.90; H, 1.36 |
| Found: | C, 45.05; H, 1.97 |

This compound is referred to hereinafter as Compound 138.

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Example LXXPreparation of 4,6-dichloro-2-
(N-3,4,5,6-tetrachlorophthalimido)-1,3,5-triazine

Into a suspension containing 4.02 grams (0.04 mole) of 35% by weight KH in oil was added 100 milliliters of tetrahydrofuran and a solution containing 3,4,5,6-tetrachlorophthalimide (10.0 grams, 0.03 mole) in tetrahydrofuran at a temperature of 4°C. The mixture was stirred at room temperature for 30 minutes, cooled to 0°C and a solution containing 6.47 grams (0.04 mole) of cyanuric chloride in 150 milliliters of dry tetrahydrofuran was added. The mixture was stirred at room temperature for about 16 hours, filtered and the filtrate poured onto ice-water. The precipitate was filtered to give 20 grams of crude product. This material was extracted with hot CH_2Cl_2 . The methylene chloride solution was cooled to room temperature and hexane added to crystallize the product. Filtration gave 700 milligrams (0.002 mole) of 4,6-dichloro-2-(N-3,4,5,6-tetrachlorophthalimido)-1,3,5-triazine as a white solid having a melting point of 298°C-300°C. IR analysis of the product indicated the following:

IR(KBr) 1745, 1510, 1400, 1370, 1300 and 1235 cm^{-1} .

This compound is referred to hereinafter as Compound 139.

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Example LXXI

Preparation of 2-(4',6'-dichloro-1',
3',5'-triazin-2'-yl)-1,2-benzisothiazol-
3(2H)one 1,1-dioxide

Into a solution containing 100 grams (0.054 mole) of cyanuric chloride in 200 milliliters of acetone was added a suspension containing 10 grams (0.054 mole) of saccharin in 100 milliliters of acetone. The mixture turned homogeneous after several minutes, and 5.5 milliliters (0.054 mole) of 2,6-lutidine were added followed by stirring at room temperature under a nitrogen atmosphere for about 16 hours. The suspension was then filtered, the filtrate evaporated, and the residue was partially crystallized from CH_2Cl_2 -hexane. This solid was filtered and the filtrate evaporated to give a residue which was recrystallized from CH_2Cl_2 -hexane to give 2.0 grams (0.006 mole) of 2-(4',6'-dichloro-1',3',5'-triazin-2'-yl)-1,2-benzisothiazol-3(2H)one 1,1-dioxide. Elemental analysis of the product indicated the following:

| | |
|-------------|--|
| Analysis: | $\text{C}_{10}\text{H}_4\text{O}_3\text{Cl}_2\text{N}_4\text{S}$ |
| Calculated: | C, 38.60; H, 1.30; N, 18.01; Cl, 22.79 |
| Found: | C, 36.59; H, 1.43; N, 16.27; Cl, 20.71 |

This compound is referred to hereinafter as Compound 140.

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Example LXXIIPreparation of 2,4-dichloro-6-trimethylsilylethynyl-1,3,5-triazine

Ethylmagnesium bromide (35.4 milliliters of 2 M tetrahydrofuran solution) was added dropwise to a solution of trimethylsilylacetylene (14.4 milliliters, 0.1 mole) in tetrahydrofuran (80 milliliters) at a temperature of -60°C . The solution was allowed to warm to room temperature, stirred for 2 hours and then heated at 40°C for 1 hour. The solution was cooled to room temperature and then added dropwise to a solution of cyanuric chloride (12 grams, 0.07 mole) in tetrahydrofuran (65 milliliters). After 1 hour at room temperature, the solvent was evaporated and the residue extracted with ether. The ether was evaporated and the residue chromatographed on silica gel to afford 1.2 grams (0.005 mole) of 2,4-dichloro-6-trimethylsilylethynyl-1,3,5-triazine as a brown oil. Elemental analysis of the product indicated the following:

| | |
|-------------|--|
| Analysis: | $\text{C}_8\text{H}_9\text{Cl}_2\text{N}_3\text{Si}_1$ |
| Calculated: | C, 39.03; H, 3.69; N, 17.07 |
| Found: | C, 39.67; H, 3.90; N, 15.97 |

The compound is referred to hereinafter as Compound 141.

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Example LXXIIIPreparation of 2,4-dichloro-6-ethoxyethynyl-1,3,5-triazine

Into ethylmagnesium bromide (21.0 milliliters of a 2M solution in tetrahydrofuran) was added dropwise a solution of ethoxyacetylene (3.0 grams, 0.04 mole) in tetrahydrofuran (21 milliliters) at a temperature of 0°C. After the addition was complete, the reaction mixture was heated to 40°C for 1 hour, cooled to 0°C and then added dropwise to a solution of cyanuric chloride (7.9 grams, 0.04 mole) in tetrahydrofuran (21 milliliters). The reaction mixture was stirred for about 16 hours, the solvent evaporated, and the residue extracted with ether. The ether was evaporated and the residue chromatographed on silica gel to afford 1.5 grams (0.007 mole) of 2,4-dichloro-6-ethoxyethynyl-1,3,5-triazine as an orange oil. NMR analysis of the product indicated the following: $^1\text{H NMR}(\text{CDCl}_3)$: δ 1.4(t, 3H); 4.55(q, 2H) ppm.

This compound is referred to hereinafter as Compound 142.

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Example LXXIVPreparation of 2,4-dichloro-6-methylsulfonamido-1,3,5-triazine

Into a mixture containing methanesulfonamide (9.5 grams, 0.1 mole) and sodium hydroxide (4 grams, 0.1 mole) in water (0.5 liter) at a temperature of 25°C was added a solution containing cyanuric chloride (18.4 grams, 0.1 mole) in acetone (100 milliliters). After the addition was completed, sodium hydroxide (4 grams, 0.1 mole) in water (25 milliliters) was added dropwise while maintaining the pH of the reaction mixture below 8.0. The reaction mixture was placed in the refrigerator for about 16 hours, warmed to room temperature and filtered to afford a white solid. Recrystallization from chloroform gave 400 milligrams (0.002 mole) of 2,4-dichloro-6-methylsulfonamido-1,3,5-triazine as a white solid having a melting point of 204°C-206°C. Elemental analysis of the product indicated the following:

| | |
|-------------|------------------------------|
| Analysis: | $C_4H_4Cl_2N_4O_2S$ |
| Calculated: | C, 19.76; H, 1.66; N, 23.05. |
| Found: | C, 19.48; H, 1.68; N, 22.44. |

This compound is referred to hereinafter as Compound 143.

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Example LXXVPreparation of 2,4-dichloro-6-(1'-piperidinoamino)-1,3,5-triazine

Into a solution containing cyanuric chloride (5.0 grams, 0.03 mole) in acetone (120 milliliters) at a temperature of 0°C was added dropwise a solution containing 2,6-lutidine (3.15 milliliters, 0.03 mole) and N-aminopiperidine (2.7 grams, 0.03 mole) in acetone (21 milliliters) while maintaining the temperature below 5°C. After 2 hours of stirring, the reaction mixture was warmed to room temperature and stirred for 1 hour. The reaction mixture was then filtered and the filtrate evaporated. The residue was chromatographed on silica gel to afford 620 milligrams (0.002 mole) of 2,4-dichloro-6-(1'-piperidinoamino)-1,3,5-triazine as a yellow solid having a melting point of 114°C-117°C. Elemental analysis of the product indicated the following:

Analysis: $C_8H_{11}Cl_2N_5$
Calculated: C, 38.72; H, 4.47; N, 28.23.
Found: C, 37.31; H, 4.51; N, 26.75.

This compound is referred to hereinafter as Compound 144.

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Example LXXVIPreparation of 2,4-bis-
(dimethylamino)-6-chloro-1,3,5-triazine

Into a solution containing cyanuric chloride (92.2 grams, 0.5 mole) dissolved in acetone (350 milliliters) and cooled to a temperature of -30°C was added liquid dimethylamine (90 grams, 2.0 moles) while maintaining the reaction temperature below -20°C. After reaction mixture ceased stirring, the internal temperature rose to 5°C. The reaction mixture was then poured onto crushed ice (2 kilograms) and the acetone evaporated by blowing air over the surface while maintaining the mixture at 0°C. After filtration, the solid (124 grams) was recrystallized from pentane and chromatographed on silica gel to afford 400 milligrams (0.002 mole) of 2,4-bis(dimethylamino)-6-chloro-1,3,5-triazine as a yellow solid having a melting point of 62°C-64°C. Elemental analysis of the product indicated the following:

| | |
|-------------|-----------------------------|
| Analysis: | $C_7H_{12}ClN_5$ |
| Calculated: | C, 41.69; H, 6.00; N, 34.73 |
| Found: | C, 41.32; N, 5.94; N, 35.18 |

This compound is referred to hereinafter as Compound 145.

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Example LXXVIIPreparation of 2,4,-dichloro-6-
dimethylamino-1,3,5-triazine

Into a solution containing cyanuric chloride (92.2 grams, 0.5 mole) dissolved in acetone (380 milliliters) and cooled to a temperature of -30°C was added dropwise 40% aqueous dimethylamine (79 grams, 0.7 mole) while maintaining the reaction temperature below -20°C . After addition was completed, the reaction mixture was stirred at -10°C for 30 minutes. The reaction mixture was poured onto crushed ice (2 kilograms) and the acetone evaporated by blowing air over the surface while maintaining the mixture at 0°C . After filtration, the solid was recrystallized from pentane to afford 59.0 grams (0.3 mole) of 2,4-dichloro-6-dimethylamino-1,3,5-triazine as a white solid having a melting point of 111.5°C - 115.5°C . Elemental analysis of the product indicated the following:

| | |
|-------------|---|
| Analysis: | $\text{C}_5\text{H}_6\text{Cl}_2\text{N}_4$ |
| Calculated: | C, 31.11; H, 3.13; N, 29.03 |
| Found: | C, 31.06; H, 3.06; N, 29.46 |

This compound is referred to hereinafter as Compound 146.

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Example LXXVIIIPreparation of 2,4-dichloro-6-
(1-morpholinyl)-1,3,5-triazine

Into a solution containing cyanuric chloride (18.4 grams, 0.1 mole) in acetone (120 milliliters) and crushed ice-water (200 milliliters) was added dropwise morpholine (17.4 grams, 0.1 mole) while maintaining the reaction temperature below 5°C. To this mixture was added a sodium hydroxide solution (25 milliliters of 2N solution) while keeping the temperature below 5°C and the pH below 8.0. The reaction mixture was filtered and the separated solid recrystallized from ether to afford 8.0 grams (0.03 mole) of 2,4-dichloro-6-(1-morpholinyl)-1,3,5-triazine as a white solid having a melting point of 154°C-157°C. Elemental analysis of the product indicated the following:

Analysis: $C_7H_8Cl_2N_4O$

Calculated: C, 35.76; H, 3.43; N, 23.84

Found: C, 35.58; H, 3.60; N, 23.83

This compound is referred to hereinafter as Compound 147.

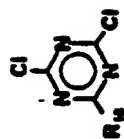
Example LXXIX



In a manner similar to that employed in Example LXXVIII, other compounds were prepared. The structures and analytical data for Compounds 148 and

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149. which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table H below.

TABLE II
Representative Heterocyclic Nitrogen - Containing Compounds



| Compound No. | Substituents | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|---|--------------------|------|-------|-------|------|-------|--------------------|
| | | Calculated | | | Found | | | |
| | | C | H | N | C | H | N | |
| 148 |  | 41.22 | 4.32 | 24.04 | 41.08 | 4.19 | 23.86 | 82-85 |
| 149 |  | 38.38 | 3.68 | 25.58 | 38.60 | 3.78 | 25.46 | 107-109 |

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Example LXXXPreparation of 2-bis(chloromethyl)
amino-4,6-dichloro-1,3,5-triazine

2,4-Dichloro-6-dimethylamino-1,3,5-triazine (18.0 grams, 0.09 mole) prepared in Example LXXVII was heated to a temperature of 130°C, chlorine gas introduced and the solution irradiated with ultraviolet light for a period of 5 hours. The resulting residue was chromatographed on silica gel to afford 300 milligrams (0.001 mole) of 2-bis(chloromethyl)amino-4,6-dichloro-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

Analysis: $C_5H_4Cl_4N_4$
Calculated: C, 22.92; H, 1.54; N, 21.39
Found: C, 23.10; H, 1.87; N, 21.93

This compound is referred to hereinafter as Compound 150.

Example LXXXIPreparation of 2,2'-[1,2-phenylenebis(oxy)]-
bis[4,6-dichloro-1,3,5-triazine]

In a manner similar to that employed in Example LIV, cyanuric chloride was reacted with 1,2-dihydroxybenzene in the presence of 2,6-lutidine

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as an acid acceptor to give 2,2'-[1,2-phenylenebis (oxy)]-bis[4,6-dichloro-1,3,5-triazine] having a melting point of 154°C-156°C. Elemental analysis of the product indicated the following:

Analysis: $C_{12}H_4Cl_4N_6O_2$
Calculated: C, 35.50; H, 0.99; N, 20.70
Found: C, 35.60; H, 1.29; N, 20.68

This compound is referred to hereinafter as Compound 151.

Example LXXXII

Preparation of 2,4-dibromo-6-isopropoxy- 1,3,5-triazine

Part A. Preparation of 2,4-dichloro- 6-isopropoxy-1,3,5-triazine

Into a stirred solution containing 20.0 grams (0.108 mole) of cyanuric chloride in 150 milliliters of acetone was added 12.6 milliliters (0.12 mole) of 2,6-lutidine dropwise at temperature of -70°C. 2-Propanol (8.3 milliliters, 0.11 mole) was added and the resulting mixture stirred under a nitrogen atmosphere at room temperature for about 16 hours. The reaction mixture was then evaporated free of solvent and the residue partitioned between ethyl ether and water. The organic layer was dried (anhydrous Na_2SO_4), evaporated and the residue distilled in vacuo to give 2.0 grams (0.01 mole) of

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2,4-dichloro-6-isopropoxy-1,3,5-triazine as an oil having a boiling point of 152°C- 155°C/42 millimeters Hg.

Part B. Preparation of 2,4-dibromo-6-isopropoxy-1,3,5-triazine

2,4-Dichloro-6-isopropoxy-1,3,5-triazine prepared in Part A was treated with gaseous hydrogen bromide in a methylene chloride solution at a temperature of 25°C by employing a procedure similar to that described in Example XIX to give 2,4,-dibromo-6-isopropoxy-1,3,5-triazine as an unstable solid. Elemental analysis of the product indicated the following:

| | |
|-------------|---|
| Analysis: | $C_6H_7Br_2N_3O$ |
| Calculated: | C, 24.24; H, 2.36; N, 14.14; Br, 53.87 |
| Found: | C, 21.14; H, 2.83; N, 13.89; Br, 53.88 |

This compound is referred to hereinafter as Compound 152.

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Example LXXXIIIPreparation of 5-(3',5'-dichlorophenoxy)-
3,6-dichloro-1,2,4-triazinePart A. Preparation of 3,5,6-trichloro-
1,2,4-triazine

A mixture containing 6-azauracil (50 grams, 0.44 mole), bromine (49.8 milliliters, 1.0 mole), and water (625 milliliters) was stirred with a magnetic stirrer for 27 hours. The mixture was filtered to yield a white powder. Concentration of the filtrate gave additional product that was combined with the first. The white solid was recrystallized from water and dried to give 53.4 grams (0.33 mole) of 5-bromo-6-azauracil having a melting point of 234°C-237°C.

Into 14.4 grams (0.08 mole) of 5-bromo-6-azauracil prepared above in 299.5 milliliters (3.4 mole) of phosphorus oxychloride was added 30.0 grams (0.14 mole) of phosphorus pentachloride and 30 milliliters (0.19 mole) of N,N-diethylaniline. The mixture was magnetically stirred and heated under reflux for 2 hours and allowed to stand at room temperature for 24 hours. The excess solvent was removed under reduced pressure and the residue extracted with eight 200 milliliters portions of dry ether. The ether was removed and the residue distilled at 70°C/0.007 millimeters to give 8.77 grams (0.05 mole) of 3,5,6-trichloro-1,2,4-triazine having a melting point of 56°C-58°C.

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Part B. Preparation of 5-(3',5'-dichlorophenoxy)-3,6-dichloro-1,2,4-triazine

Into a solution containing 1.84 grams (0.01 mole) of 3,5,6-trichloro-1,2,4-triazine prepared in Part A in 50 milliliters of acetone was added, with cooling and stirring, 1.07 grams (0.01 mole) of 2,6-lutidine and 1.63 grams (0.01 mole) of 3,5-dichlorophenol dissolved in 10 milliliters of acetone at such a rate that the reaction temperature remained at 0-5°C. The reaction mixture was magnetically stirred for 2 hours and allowed to warm to room temperature. The precipitated 2,6-lutidine hydrochloride was filtered off and washed in 50 milliliters of acetone. The acetone solution was poured onto about 100 grams of ice and the product that precipitated was collected and washed with 20 milliliters of cold 10% aqueous NaOH and 10 milliliters of cold water. The solid was dried and crystallized from hexane to give 2.3 grams (0.007 mole) of 5-(3',5'-dichlorophenoxy)-3,6-dichloro-1,2,4-triazine as a white solid having a melting point of 130°C-132°C. Elemental analysis of the product indicated the following:

| | |
|-------------|-----------------------------|
| Analysis: | $C_9H_3Cl_4N_3O$ |
| Calculated: | C, 34.76; H, 0.97; N, 13.51 |
| Found: | C, 34.64; H, 0.93; N, 13.69 |

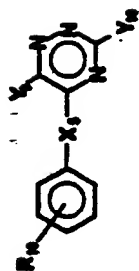
This compound is referred to hereinafter as Compound 153.

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Example LXXXIX

In a manner similar to that employed in Example LXXXVIII, other compounds were prepared. The structures and analytical data for Compounds 154 through 156, which compounds were used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table I below.

TABLE I
Representative Heterocyclic Nitrogen - Containing Compounds



| Compound No. | Substituents | | | | Elemental Analysis | | | | | | Melting Point (°C) |
|-----------------|---------------------|----------------|----------------|-----------------|--------------------|------|-------|------|-------|---------|--------------------------|
| | R ₁₉ | X ₅ | Y ₉ | Y ₁₀ | Calculated | | Found | | M | | |
| | | | | | C | H | C | H | | | |
| 154 | 4-NO ₂ | O | Cl | Cl | 37.66 | 1.40 | 37.71 | 1.74 | 19.63 | 169-172 | |
| 155 | 4-CN | O | Cl | Cl | 44.97 | 1.51 | 44.88 | 1.67 | 21.14 | 149-152 | |
| 156 | 2,4-Cl ₂ | NH | Cl | Cl | 34.87 | 1.30 | 34.86 | 1.42 | 17.44 | 175-177 | |

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Example XCPreparation of 5-(2',4'-dichlorophenoxy)-
3,6-dichloro-1,2,4-triazine

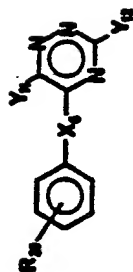
3,5,6-Trichloro-1,2,4-triazine and 2,4-dichlorophenol were reacted in an acetone solution employing quinaldine as the acid acceptor in a manner similar to that employed in Example III to give 3.0 grams (0.01 mole) of 5-(2',4'-dichlorophenoxy)-3,6-dichloro-1,2,4-triazine having a melting point of 90°C-93°C after recrystallization from hexane. Infrared analysis of the product indicated the following: IR (KBr) 3090, 1530, 1505, 1470, 1400, 1295, 1235, 1205, 1100, 1050, 985, 865, 830, 750 cm^{-1} .

This compound is referred to hereinafter as Compound 157.

Example XCI

In a manner similar to that employed in Example XC, other compounds were prepared. The structure and analytical data for Compounds 158 through 160, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table J below.

TABLE I
Representative Heterocyclic Nitrogen - Containing Compounds



| Compound No. | R20 | Substituents | | | | | Elemental Analysis | | | | | Melting Point (°C) |
|--------------|----------|--------------|-----|-----|------------|------|--------------------|-------|------|-------|---------|--------------------|
| | | H6 | Y11 | Y12 | Calculated | | Found | | | | | |
| | | | | | C | H | C | H | N | | | |
| 158(a) | 4-CH3S- | 0 | Cl | Cl | 41.68 | 2.45 | 14.58 | 41.80 | 2.65 | 14.78 | 123-125 | |
| 159 | 3,5-Cl2 | S | Cl | Cl | 33.05 | 0.92 | 12.85 | 33.52 | 0.95 | 12.47 | 114-117 | |
| 160 | 3-C6H5O- | NH | Cl | Cl | 54.07 | 3.03 | 16.62 | 54.32 | 2.84 | 16.96 | 132-134 | |

(a) 2,6-Lutidine was employed as the acid acceptor in place of quinaldine.

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Example XCIIPreparation of 2,6-dichlorobenzaldehyde
O-(3,6-dichloro-1,2,4-triazin-4-yl)oxime

In a manner similar to that employed in Example XXXVI, 3,5,6-trichloro-1,2,4-triazine was reacted with 2,6-dichlorobenzaldoxime to give 0.93 gram (0.003 mole) of 2,6-dichlorobenzaldehyde O-(3,6-dichloro-1,2,4-triazin-4-yl)oxime having a melting point of 103°C-105°C. Elemental analysis of the product indicated the following:

| | |
|-------------|---|
| Analysis: | C ₁₀ H ₄ Cl ₄ N ₄ O |
| Calculated: | C, 35.54; H, 1.19; N, 16.58 |
| Found: | C, 35.76; H, 1.60; N, 17.04 |

This compound is referred to hereinafter as Compound 161.

Example XCIIIPreparation of 3-chloro-6-
(2',4'-dichlorophenoxy)pyridazine

A mixture containing 5.96 grams (0.04 mole) of 3,6-dichloropyridazine, 6.52 grams (0.04 mole) of 2,4-dichlorophenol, and 5.80 grams (0.04 mole) of K₂CO₃ in 200 milliliters of acetone was heated on a steam bath for a period of 2 hours. The solvent was removed and the residue washed with 100

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milliliters of 10% aqueous NaOH and then 100 milliliters of water. The crude solid was crystallized from hexane to give a total of 1.6 grams (0.006 mole) of 3-chloro-6-(2',4'-dichlorophenoxy)pyridazine as a white solid having a melting point of 89°C-91°C. Elemental analysis of the product indicated the following:

Analysis: $C_{10}H_5Cl_3N_2O$
Calculated: C, 43.59; H, 1.83; N, 10.17
Found: C, 43.59; H, 1.91; N, 10.06

This compound is referred to hereinafter as Compound 162.

Example XCIV

In a manner similar to that employed in Example XCIII, other compounds were prepared. The structures and analytical data for Compound 163, which compound is used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table K below.

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Example XCVPreparation of tris(4,6-dichloro-
1,3,5-triazin-2-yl)amine

In the procedure employed in Example LVI for the preparation of bis(4,6-dichloro-1,3,5-triazin-2-yl)amine, a solid precipitate was isolated by filtration to give tris(4,6-dichloro-1,3,5-triazin-2-yl)amine as a by-product having a melting point of greater than 360°C (dec.). Elemental analysis of the product indicated the following:

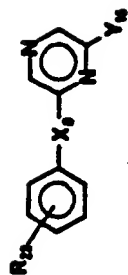
| | |
|-------------|-----------------------------|
| Analysis: | $C_9Cl_6N_{10}$ |
| Calculated: | C, 23.45; H, 0.00, N, 30.39 |
| Found: | C, 21.85; H, 1.18; N, 33.65 |

This compound is referred to hereinafter as Compound 164.

Example XCVI

In a manner similar to that employed in Example XCIII, other compounds were prepared. The structures and analytical data for Compound 165, which compound is used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table L below.

TABLE I
Representative Heterocyclic Nitrogen - Containing Compounds



| Compound No. | Substituents | | | Elemental Analysis | | | | | | Melting Point (°C) |
|-----------------|--------------|----|-----|--------------------|------|-------|-------|------|------|--------------------------|
| | R22 | Xg | Y15 | Calculated | | | Found | | | |
| | | | | C | H | N | C | H | N | |
| 165 | 2,4-Cl2 | 0 | Cl | 43.59 | 1.83 | 10.17 | 43.62 | 1.62 | 9.97 | 95-97 |

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Example XCVIIPreparation of 3-chloro-6-
(3'-chlorophenoxy)pyridazine

Into a solution containing 1.93 grams (0.015 mole) of 3-chlorophenol and 1.5 grams (0.005 mole) of tetrabutylammonium bromide in 24 milliliters of 1.25 N aqueous sodium hydroxide was added 2.23 grams (0.015 mole) of 3,6-dichloro-pyridazine dissolved in 50 milliliters of toluene. The mixture was heated to a temperature of 50°C and stirred for 3 hours. The organic layer was separated, washed with dilute NaOH solution and water, dried over MgSO_4 and evaporated. The residue obtained was crystallized from hexane to give 1.55 grams (0.006 mole) of 3-chloro-6-(3'-chloro-phenoxy)pyridazine as a white solid having a melting point of 85°C-88°C. Elemental analysis of the product indicated the following:

| | |
|-------------|--|
| Analysis: | $\text{C}_{10}\text{H}_6\text{Cl}_2\text{N}_2\text{O}$ |
| Calculated: | C, 49.82; H, 2.51; N, 11.62 |
| Found: | C, 49.87; H, 2.48; N, 11.65 |

This compound is referred to hereinafter as Compound 166.

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Example XCVIIIPreparation of 4-(4'-nitrophenoxy)
-2,5,6-trichloropyrimidine

In a manner similar to that employed in Example I, 2,4,5,6-tetrachloropyrimidine and 4-nitrophenol were reacted in acetone solution employing 2,6-lutidine as the acceptor to give 0.8 gram (0.002 mole) of 4-(4'-nitrophenoxy)-2,5,6-trichloropyrimidine having a melting point of 114°C-116°C following vacuum sublimation and two recrystallizations from hexane. Elemental analysis of the product indicated the following:

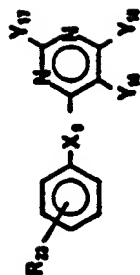
| | |
|-------------|---|
| Analysis: | $C_{10}H_4Cl_3N_3O_3$ |
| Calculated: | C, 37.47; H, 1.26; N, 13.11; Cl, 33.18 |
| Found: | C, 36.89; H, 1.52; N, 13.00; Cl, 32.79 |

This compound is referred to hereinafter as Compound 167.

Example XCIX

In a manner similar to that employed in Example XCVIII, other compounds were prepared. The structures and analytical data for Compounds 168 and 169, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table M below.

TABLE A
Representative Heterocyclic Nitrogen - Containing Compounds



| Compound No. | Substituents | | | | | Elemental Analysis | | | | | | Melting Point (°C) |
|-----------------|---------------------|----------------|-----------------|-----------------|-----------------|--------------------|------|-------|-------|------|------|--------------------------|
| | R ₂₃ | X ₉ | Y ₁₆ | Y ₁₇ | Y ₁₈ | Calculated | | Found | | M | | |
| | | | | | | C | H | C | H | | | |
| 168 | 3,5-Cl ₂ | 0 | Cl | Cl | Cl | 34.07 | 0.88 | 8.13 | 35.06 | 0.66 | 0.15 | 94-96 |
| 169 | 2,4-Cl ₂ | 0 | Cl | Cl | Cl | 34.87 | 0.88 | 8.13 | 35.14 | 1.04 | 0.29 | 108-112 |

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Example CPreparation of 2-(2',4'-dichlorophenoxy)
pentachlorocyclotriphosphazene

Into a solution containing 10.8 grams (0.03 mole) of phosphonitrilic chloride trimer in 50 milliliters of acetone at a temperature of -60°C and under nitrogen atmosphere was added dropwise 3.1 milliliters (0.03 mole) of 2,6-lutidine in 10 milliliters of acetone and 5.0 grams (0.03 mole) of 2,4-dichlorophenol in 40 milliliters of acetone. The reaction mixture was allowed to warm to room temperature, stirred for about 16 hours, filtered and the filtrate poured into ice water. The solid (6.8 grams) was collected by filtration, and sublimation removed the unconverted 2,4-dichlorophenol. The pink semi-solid remaining in the sublimer was collected to give 0.9 gram (0.002 mole) of 2-(2',4'-dichlorophenoxy)pentachlorocyclotriphosphazene. NMR analysis of the product indicated the following: ¹H NMR (CDCl₃): δ 7.20-7.55 ppm (m, aromatic protons).

This compound is referred to hereinafter as Compound 170.

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Example CIPreparation of 2,4-dichloro-6-(2',4'-dichlorophenoxy)hexahydro-1,3,5-triazine

Into a suspension containing 340 milligrams (0.001 mole) of 2,4-dichloro-6-(2',4'-dichlorophenoxy)-1,3,5-triazine in 50 milliliters of anhydrous ethyl ether was added 400 milligrams (0.01 mole) of sodium borohydride and 5 milliliters of methanol in portions. The mixture was stirred for 5 minutes and an additional 420 milligrams (0.01 mole) of sodium borohydride was added. After the mixture was stirred for 15 minutes, 150 milliliters of ether was added and the mixture then partitioned between ether and water. The organic layer was dried (Na_2SO_4) and evaporated to give 340 milligrams (0.001 mole) of 2,4-dichloro-6-(2',4'-dichlorophenoxy)hexahydro-1,3,5-triazine as a white unstable solid. NMR analysis of the product indicated the following:

^{13}C NMR($\text{CD}_3\text{CN}/\text{D}_2\text{O}$): δ 118.53, 121.86, 124.87, 125.71, 128.82, 129.5, 130.09 and 130.93 ppm.

This compound is referred to hereinafter as Compound 171.

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Example CII

Preparation of 2,4-dichloro-6-
[4-(4-ethoxyphenylazo)-1-naphthoxy]-
1,3,5-triazine

In a manner similar to that employed in Example LIII, 2,4-dichloro-6-[4-(4-ethoxyphenylazo)-1-naphthoxy]-1,3,5-triazine was prepared having a melting point of 173°C-177°C. Elemental analysis of the product indicated the following:

| | |
|-------------|-----------------------------|
| Analysis: | $C_{21}H_{15}Cl_2N_5O_2$ |
| Calculated: | C, 57.29; H, 3.43; N, 15.90 |
| Found: | C, 57.52; H, 4.08; N, 15.66 |

This compound is referred to hereinafter as Compound 172.

Example CIII

Preparation of 2,4-dichloro-6-(2-methoxyphenoxy)-
1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 2-methoxyphenol in the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-(2-methoxyphenoxy)-1,3,5-triazine having a melting point of 93°C-94.5°C. Elemental analysis of the product indicated the following:

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Analysis: $C_{10}H_7Cl_2N_3O_2$
Calculated: C, 44.14; H, 2.59; N, 15.44
Found: C, 43.99; H, 3.00; N, 15.27

This compound is referred to hereinafter as Compound 173.

Example CIV

Preparation of 2,4-dichloro-6-(2-benzyloxyphenoxy)-
1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 2-benzyloxyphenol in the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-(2-benzyloxyphenoxy)-1,3,5-triazine having a melting point of 92°C-94°C. Elemental analysis of the product indicated the following:

Analysis: $C_{16}H_{11}Cl_2N_3O_2$
Calculated: C, 55.19; H, 3.18; N, 12.07
Found: C, 55.59; H, 3.19; N, 11.76

This compound is referred to hereinafter as Compound 174.

Example CV

Preparation of 2,4-dichloro-6-[4-(1-methyl-
1-[4-propoxyphenyl]ethyl)phenoxy]-1,3,5-triazine

Part A. Preparation of 4-[1-methyl-1-(4-
propoxyphenyl)ethyl]phenol

A mixture of Bisphenol A (5.0 grams, 0.02 mole), potassium carbonate (3.04 grams, 0.02 mole)

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and 100 milliliters of acetophenone was stirred and heated at a temperature of 150°C for a period of 2 hours. After cooling to room temperature, 1-iodopropane (3.22 milliliters, 0.03 mole) was added and the mixture was then stirred and heated at a temperature of 100°C for a period of about 16 hours. The reaction mixture was then allowed to cool and the solid removed by filtration. The acetophenone was removed by distillation under reduced pressure and the residue purified by flash chromatography (5% ethyl acetate/hexane eluant) to give 2.12 grams (0.008 mole) of 4-[1-methyl-1-(4-propoxyphenyl)-ethyl]phenol. NMR analysis of the phenol intermediate indicated the following: ¹H NMR (CDCl₃): δ 0.80-1.91 (m, 11H), 3.90 (t, 2H, J = 7Hz), 5.15 (s, H), 6.57-7.21 (m, 8H) ppm.

Part B. Preparation of 2,4-dichloro-6-[4-(1-methyl-1-[4-propoxyphenyl]-ethyl)]phenoxy-1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 4-[1-methyl-1-(4-propoxyphenyl)-ethyl]phenol prepared in Part A above in the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-[4-(1-methyl-1-[4-propoxyphenyl]-ethyl)]phenoxy-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

| | |
|-------------|---|
| Analysis: | C ₂₁ H ₂₁ Cl ₂ N ₃ O ₂ |
| Calculated: | C, 60.30; H, 5.06; N, 10.04 |
| Found: | C, 59.62; H, 5.06; N, 10.84 |

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This compound is referred to hereinafter as Compound 175.

Example CVI

Preparation of 2,4-dichloro-6-[4-(1-methyl-1-[4-methoxyphenyl]ethyl)]phenoxy-1,3,5-triazine

Part A. Preparation of 4-[1-methyl-1-(4-methoxyphenyl)ethyl]phenol

In a manner similar to that employed in Part A of Example CV, Bisphenol A was reacted with methyl iodide in acetone solution and in the presence of potassium carbonate as an acid acceptor to give 4-[1-methyl-1-(4-methoxyphenyl)ethyl]phenol. NMR analysis of the phenol intermediate indicated the following: ¹H NMR (CDCl₃): δ 1.63 (s, 6H), 3.77 (s, 3H), 5.62 (s, H), 6.55-7.27 (m, 8H) ppm.

Part B. Preparation of 2,4-dichloro-6-[4-(1-methyl-1-[4-methoxyphenyl]ethyl)]phenoxy-1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 4-[1-methyl-1-(4-methoxyphenyl)ethyl]phenol prepared in Part A above in the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-[4-(1-methyl-1-[4-methoxyphenyl]ethyl)]phenoxy-1,3,5-triazine having a melting point of 108°C-111°C. Elemental analysis of the product indicated the following:

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Analysis: $C_{19}H_{17}Cl_2N_3O_2$
Calculated: C, 58.47; H, 4.39; N, 10.77
Found: C, 58.35; H, 4.40; N, 10.76

This compound is referred to hereinafter as Compound 176.

Example CVII

Preparation of 2,4-dichloro-6-[4-(1-methyl-1-[4-benzyloxyphenyl]ethyl)]-phenoxy-1,3,5-triazine

Part A. Preparation of 4-[1-methyl-1-(4-benzyloxyphenyl)ethyl]phenol

In a manner similar to that employed in Part A of Example CV, Bisphenol A was reacted with benzyl chloride in acetone solution in the presence of potassium carbonate as an acid acceptor to give 4-[1-methyl-1-(4-benzyloxyphenyl)ethyl]phenol. NMR analysis of the phenol intermediate indicated the following: 1H NMR ($CDCl_3$): δ 1.60 (s, 6H), 4.57 (s, H), 5.00 (s, 2H), 6.56-7.48 (m, 8H) ppm.

Part B. Preparation of 2,4-dichloro-6-[4-(1-methyl-1-[4-benzyloxyphenyl]ethyl)]-phenoxy-1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 4-[1-methyl-1-(4-benzyloxyphenyl)ethyl]phenol prepared in Part A above in the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-[4-(1-methyl-1-[4-benzyloxyphenyl]ethyl)]phenoxy-1,3,5-triazine having a melting point

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of 117.5°C-119°C. Elemental analysis of the product indicated the following:

Analysis: $C_{25}H_{21}Cl_2N_3O_2$
Calculated: C, 64.39; H, 4.54; N, 9.01
Found: C, 64.09; H, 4.59; N, 8.87

This compound is referred to hereinafter as Compound 177.

Example CVIII

Preparation of 2,4-dichloro-6-(2-n-butyloxyphenoxy)- 1,3,5-triazine

Part A. Preparation of 2-(n-butyloxy)phenol

In a manner similar to that employed in Part A of Example XXII, catechol was reacted with 1-bromobutane in the presence of sodium hydroxide as an acid acceptor to give 2-(n-butyloxy)phenol. NMR analysis of the phenol intermediate indicated the following: 1H NMR ($CDCl_3$): δ 0.73-1.95 (m, 7H), 3.63-4.08 (t, 2H), 6.02-7.32 (m, 4H) ppm.

Part B. Preparation of 2,4-dichloro-6-(2-n-butyloxy- phenoxy)-1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 2-(n-butyloxy)phenol prepared in Part A above the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-(2-n-butyloxyphenoxy)-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

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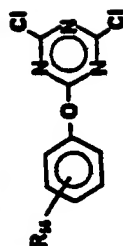
Analysis: $C_{13}H_{13}Cl_2N_3O_2$
Calculated: C, 49.70; H, 4.17; N, 13.37
Found: C, 50.82; H, 4.69; N, 12.98

This compound is referred to hereinafter as Compound 178.

Example CIX

In a manner similar to that employed in Example CVIII, other compounds were prepared. The structures and analytical data for Compounds 179 through 184, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table N below.

TABLE II
Representative Heterocyclic Nitrogen-Containing Compounds






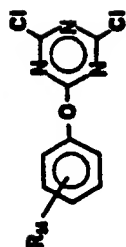
| Compound No. | Substituents R ₅₅ | Elemental Analysis | | | | Melting Point (°C) |
|--------------|---|--------------------|------|-------|------|--------------------|
| | | Calculated | | Found | | |
| | | C | H | C | H | |
| 179 |  | 53.11 | 4.16 | 51.94 | 4.53 | 12.80 011 |
| 180 |  | 57.46 | 4.02 | 57.44 | 4.05 | 11.01 164.5-165.5 |
| 181 |  | 61.88 | 5.65 | 62.01 | 5.81 | 9.17 141.5-142.5 |

TABLE IV (Cont.)
Representative Heterocyclic Nitrogen-Containing Compounds



| Compound No. | Substituents R ₅₅ | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|---------------------------------|--------------------|------|-------|-------|------|-------|--------------------|
| | | Calculated | | | Found | | | |
| | | C | H | N | C | H | N | |
| 182 | | 56.37 | 3.61 | 11.60 | 56.41 | 3.88 | 11.87 | 136.0-137.0 |
| 183 | | 58.55 | 4.38 | 10.75 | 58.08 | 4.50 | 10.74 | 91.5-93.0 |
| 184 | | 63.03 | 3.91 | 9.59 | 62.95 | 4.20 | 9.27 | 113.5-115.0 |

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Example CXPreparation of 2,4-dichloro-6-[4-(4-benzyloxy-phenylthio)]phenoxy-1,3,5-triazinePart A. Preparation of 4-[(4-benzyloxyphenylthio)]-phenol

A mixture of 5.0 grams (0.02 mole) of 4,4'-thiobisphenol, 3.79 grams (0.03 mole) of potassium carbonate and 75 milliliters of acetone was heated under reflux for a period of 2 hours. After cooling to room temperature, 4.35 grams (0.03 mole) of benzyl chloride added dropwise to the reaction mixture which was then heated under reflux for a period of 16 hours. The reaction mixture was then cooled to room temperature and filtered through Celite to remove solid materials. The filtrate was concentrated in vacuo and the residue purified by flash chromatography to give 2.82 grams (0.01 mole) of 4-[(4-benzyloxy- phenylthio)]phenol. NMR analysis of the phenol intermediate indicated the following: ¹H NMR (CDCl₃): δ 4.98 (s, H), 5.08 (s, 2H), 6.65-7.50 (m, 13H) ppm.

Part B. Preparation of 2,4-dichloro-6-[4-(4-benzyloxyphenylthio)]phenoxy-1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 4-[(4-benzyloxyphenylthio)]phenol prepared in Part A above in the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-[4-(4-benzyloxyphenylthio)]phenoxy-1,3,5-triazine having a melting point of 119°C-120°C.

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Elemental analysis of the product indicated the following:

Analysis: $C_{22}H_{15}Cl_2N_3O_2S$

Calculated: C, 57.90; H, 3.31; N, 9.20

Found: C, 58.49; H, 3.60; N, 8.94

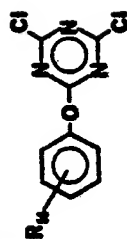
This compound is referred to hereinafter as Compound 185.



Example CXI

In a manner similar to that employed in Example CX, other compounds were prepared. The structures and analytical data for Compounds 186 and 187, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table O below.

TABLE 0

Representative Heterocyclic Nitrogen-Containing Compounds



| Compound No. | Substituents R56 | Elemental Analysis | | | | Melting Point (°C) | |
|-----------------|---|--------------------|------|-------|------|--------------------------|-------------|
| | | Calculated | | Found | | | |
| | | C | H | C | H | | |
| 186 |  | 52.95 | 3.70 | 52.89 | 3.72 | 10.56 | 77.0-80.0 |
| 187 |  | 50.54 | 2.92 | 50.33 | 3.17 | 10.72 | 107.0-109.0 |

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Example CXIIPreparation of 2-chloro-4-methyl-6-[4-(1-methyl-1-[4-methoxyphenyl]ethyl)]-phenoxy-1,3,5-triazine

To a stirred solution of 0.72 gram (0.002 mole) of 2,4-dichloro-6-[4-(1-methyl-1-[4-methoxyphenyl]ethyl)]phenoxy-1,3,5-triazine prepared in Example CVI in 50 milliliters of tetrahydrofuran was slowly added 2.04 milliliters (0.006 mole) of 2.7 M methylmagnesium bromide in ethyl ether solution while cooling the mixture in an ice bath. After this period, the reaction mixture was allowed to warm to room temperature and then stirred for a period of 15 hours. The solvents were removed by vacuum evaporation and the residue purified by flash chromatography (3% ethyl acetate in hexane eluant) to give 0.43 grams (0.001 mole) of 2-chloro-4-methyl-6-[4-(1-methyl-1-[4-methoxyphenyl]ethyl)]phenoxy-1,3,5-triazine as pale yellow crystals having a melting point of 65.0°C-67.5°C. Elemental analysis of the product indicated the following:

Analysis: $C_{20}H_{20}ClN_3O_2$

Calculated: C, 64.95; H, 5.45; N, 11.36

Found: C, 64.58; H, 5.57; N, 11.25

This compound is referred to hereinafter as Compound 188.

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Example CXIIIPreparation of 2,4-dichloro-6-[4-(chloro-phenylsulfonyl)]phenoxy-1,3,5-triazinePart A. Preparation of 4-chlorophenyl 4'-hydroxy-phenyl sulfone

To a stirred solution of 28.7 grams (0.1 mole) of bis(4-chlorophenyl) sulfone in 100 milliliters of dimethylsulfoxide was added a solution of 13.1 grams (0.23 mole) of potassium hydroxide in 15 milliliters of water over a 10 minute period while heating the reaction mixture at a temperature of 40°C. The reaction mixture was then heated at a temperature of 105°C for a period of 5 hours, cooled to room temperature and poured into 300 milliliters of water. A white, milky precipitate was filtered off and the filtrate acidified with HCl. The aqueous solution was extracted with ether (3 x 100 milliliters) and the combined ether layers washed with 10% aqueous NaOH (2 x 50 milliliters). The combined basic layers were acidified with HCl and extracted with ether (2 x 50 milliliters). Evaporation of ether gave 19.21 grams (0.08 mole) of 4-chlorophenyl 4'-hydroxyphenyl sulfone having a melting point of 143.0°C-146.0°C.

Part B. Preparation of 2,4-dichloro-6-[4-(4-chloro-phenylsulfonyl)]phenoxy-1,3,5-triazine

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with 4-chlorophenyl 4'-hydroxyphenyl sulfone prepared in Part A above in the presence of

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2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-[4-(4-chlorophenylsulfonyl)]phenoxy-1,3,5-triazine having a melting point of 167°C.

Elemental analysis of the product indicated the following:

Analysis: $C_{15}H_8Cl_3N_3O_3S$
Calculated: C, 43.24; H, 1.93; N, 10.08
Found: C, 43.16; H, 2.01; N, 10.01

This compound is referred to hereinafter as Compound 189.

Example CXIV

Preparation of bis[4-(4,6-dichloro-1,3,5-triazine-2-yloxy)phenyl] sulfone

In a manner similar to that employed in Part B of Example XXII, cyanuric chloride was reacted with bis(4-hydroxyphenyl) sulfone in the presence of 2,6-lutidine as an acid acceptor to give bis [4-(4,6-dichloro-1,3,5-triazin-2-yloxy)phenyl] sulfone having a melting point of 230°-235°C. Elemental analysis of the product indicated the following:

Analysis: $C_{18}H_8Cl_4N_6O_4$
Calculated: C, 39.58; H, 1.48; N, 15.39
Found: C, 41.30; H, 1.73; N, 14.61

This compound is referred to hereinafter as Compound 190.

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Example CXVPreparation of (4,6-dichloro-1,3,5-triazin-2-yl)
(4,6-dimethoxy-1,3,5--triazin-2-yl)etherPart A. Preparation of 2,4,6-trimethoxy-
1,3,5-triazine

To a stirred solution of 12.0 grams (0.30 mole) of sodium hydroxide in 100 milliliters of methanol was slowly added over a one hour period 18.5 grams (0.10 mole) of cyanuric chloride in small portions while maintaining the reaction temperature at 25°C-30°C. After this period, the reaction mixture was stirred at room temperature for a two hour period. The mixture was filtered and methanol evaporated from the filtrate under reduced pressure. The residue was vacuum dried and crystallized from water to give 4.3 grams (0.025 mole) of 2,4,6-trimethoxy-1,3,5-triazine having a melting point of 122°C-129°C. Reverse phase high pressure liquid chromatographic analysis indicated the product to be of approximately 75% purity.

Part B. Preparation of sodium 4,6-dimethoxy-
1,3,5-triazin-2-olate

To a stirred solution of 1.86 grams (0.05 mole) of sodium hydroxide in 25 milliliters of methanol was added 4.0 grams (0.02 mole) of 2,4,6-tri-methoxy-1,3,5-triazine prepared in Part A above which was heated under reflux for a period of one hour. The solution was allowed to cool and the white solid collected and dried to give 3.95 grams:

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(0.02 mole) of sodium 4,6-dimethoxy-1,3,5-triazin-2-olate.

Part C. Preparation of (4,6-dichloro-1,3,5-triazin-2-yl) (4,6-dimethoxy-1,3,5-triazin-2-yl) ether

Sodium 4,6-dimethoxy-1,3,5-triazin-2-olate (1.5 grams, 0.01 mole) prepared in Part B above was suspended in 25 milliliters of acetonitrile and the mixture cooled to a temperature of 5°C-10°C in an ice bath. A solution of 1.54 grams (0.01 mole) of cyanuric chloride in 25 milliliters of acetonitrile was then added dropwise with stirring while maintaining the temperature below 10°C. The reaction mixture was stirred in the ice bath and allowed to warm slowly to room temperature. After stirring for a 16 hour period, the reaction mixture was filtered and solvent removed by evaporation. A white solid residue was purified by flash chromatography (30% ethyl acetate in hexane) to give 1.34 grams (0.004 mole) of (4,6-dichloro-1,3,5-triazin-2-yl) (4,6-dimethoxy-1,3,5-triazin-2-yl) ether having a melting point of 158.5°C-160°C. Elemental analysis of the product indicated the following:

Analysis: $C_8H_6Cl_2N_6O_3$

Calculated: C, 31.50; H, 1.98; N, 27.55

Found: C, 31.74; H, 2.07; N, 27.47

This compound is referred to hereinafter as Compound 191.

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Example CXVIPreparation of 2,2'-thiobis(4,6-dichloro-1,3,5-triazine)

To a stirred solution of 10.0 grams (0.05 mole) of cyanuric chloride in 100 milliliters of acetone was added a solution of 3.26 grams (0.01 mole) of sodium sulfide nonahydrate in 30 milliliters of water over a period of 30 minutes while maintaining the temperature of the reaction mixture at 0-5°C by external cooling. The reaction mixture was stirred at a temperature of 0-5°C for a period of 15 minutes and 150 milliliters of ice water was added. A white precipitate formed and was immediately filtered off and dried. Unreacted cyanuric chloride was removed from the crude product by vacuum sublimation and the remaining solid recrystallized from hexane/methylene chloride to give 2,2'-thiobis(4,6-dichloro-1,3,5-triazine) as a white solid having a melting point of 140°C-145°C. High pressure liquid chromatographic analysis showed the product to have a purity of 75%. Infrared analysis of the product indicated the following: IR (CHCl_3) 1500, 1240, 850, cm^{-1} . Mass spectrometric analysis indicated m/e 330 (calculated molecular weight 329.98). This compound is referred to hereinafter as Compound 192.

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Example CXVIIPreparation of (4-chloro-6-methoxy-1,3,5-triazin-2-yl)(4,6-dimethoxy-1,3,5-triazin-2-yl) etherPart A. Preparation of 2,4-dichloro-6-methoxy-1,3,5-triazine

A mixture of 20.2 grams (0.11 mole) of cyanuric chloride, 18.4 grams (0.22 mole) of sodium bicarbonate, 100 milliliters of methanol and 125 milliliters of water was stirred for a period of 40 minutes at room temperature and then diluted with 100 milliliters of water and the resulting solid filtered off. The white solid was vacuum dried to give 13.4 grams (0.08 mole) of 2,4-dichloro-6-methoxy-1,3,5-triazine having a melting point of 88°C-90°C.

Part B. Preparation of (4-chloro-6-methoxy-1,3,5-triazin-2-yl) (4,6-di-methoxy-1,3,5-triazin-2-yl) ether

To a stirred suspension of 2.91 grams (0.02 mole) of sodium 4,6-dimethoxy-1,3,5-triazin-2-olate prepared in Part B of Example CXV in 50 milliliters of acetonitrile was added dropwise a solution of 2.93 grams (0.02 mole) of 2,4-dichloro-6-methoxy-1,3,5-triazine prepared in Part-A above. The reaction mixture was heated under reflux for a period of 48 hours and then refluxed for a second 48 hour period after addition of 1.17 grams (0.003 mole) of dibenzo-18-crown-6. The mixture was allowed to cool, diluted with 75 milliliters of methylene chloride and then filtered. After

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evaporation of solvents the residue was purified by flash chromatography (20% ethyl acetate in hexane eluant) to yield 1.60 grams (0.005 mole) of (4-chloro-6-methoxy-1,3,5-triazin-2-yl) (4,6-dimethoxy-1,3,5-triazin-2-yl) ether having a melting point of 126.5°C-128°C. Elemental analysis of the product indicated the following:

Analysis: $C_9H_9ClN_6O_4$

Calculated: C, 35.95; H, 3.01; N, 27.95

Found: C, 35.92; H, 3.12; N, 28.08

This compound is referred to hereinafter as Compound 193.

Example CXVIII

Preparation of 2-chloro-4,6-dimethoxy-1,3,5-triazine

A mixture of 18.5 grams (0.10 mole) of cyanuric chloride, 16.8 grams (0.20 mole) of sodium bicarbonate, 57 milliliters of methanol and 5 milliliters of water was stirred vigorously and carbon dioxide evolution was observed as the reaction temperature rose to about 40°C. After a period of 20 minutes, carbon dioxide evolution had slowed and the reaction mixture was then heated under reflux for a period of 30 minutes. The mixture was cooled and diluted with water causing a white precipitate to separate. The solid was collected, waterwashed, vacuum dried and the crude product crystallized from cyclohexane to give 10.0 grams (0.06 mole) of 2-chloro-4,6-dimethoxy-1,3,5-triazine as a white crystalline solid having a

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melting point of 69°C-71°C. Elemental analysis of the product indicated the following:

Analysis: $C_5H_6ClN_3O_2$
Calculated: C, 34.20; H, 3.44; N, 23.93
Found: C, 34.14; H, 3.60; N, 23.96

This compound is referred to hereinafter as Compound 194.

Example CXIX

Preparation of 6-(2,4-dichlorophenylazo)-
2,4-dichloro-1,3,5-triazine

A slow stream of chlorine gas was passed for a period of ten minutes through a two-phase mixture consisting of a solution of 2.6 grams (0.008 mole) of N-(2,4-dichlorophenyl)-N'-(4,6-dichloro-1,3,5-triazin-2-yl)hydrazine in 75 milliliters of $CHCl_3$ and a solution of 1.34 grams (0.02 mole) of $NaHCO_3$ in 40 milliliters of water. Nitrogen was then bubbled through the mixture to remove excess chlorine and the organic layer was separated, washed with water and dried over anhydrous $MgSO_4$ to yield 2.4 grams of a dark red solid. This was combined with 980 milligrams of product prepared from a previous identical reaction except that 1.0 gram (0.003 mole) of N-(2,4-dichlorophenyl)-N-(4,6-dichloro-1,3,5-triazin-2-yl)hydrazine was used. The combined products were flash-chromatographed on silica gel using a 9:1 v/v hexane-ethyl acetate eluent to yield the crude product as a red solid. This crude product was recrystallized from hexane to give a material which was sublimed giving 0.91 grams

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(0.003 mole) of 6-(2,4-dichlorophenylazo)-2,4-dichloro-1,3,5-triazine as a red solid having a melting point of 119°C-123°C. Elemental analysis of the product indicated the following:

Analysis: $C_9H_3Cl_4N_5$
Calculated: C, 33.47; H, 0.94; N, 21.68
Found: C, 32.95; H, 0.97; N, 21.14

This compound is referred to hereinafter as Compound 195.

Example CXX

Preparation of 2-(4-methoxyphenyl)-4,6-dichloro-1,3,5-triazine

In a manner similar to that employed in Example XL, cyanuric chloride was reacted with the Grignard reagent of 4-bromoanisole to give 2-(4-methoxy-phenyl)-4,6-dichloro-1,3,5-triazine having a melting point of 136.5°C-138.5°C. Elemental analysis of the product indicated the following:

Analysis: $C_{10}H_7Cl_2N_3O$
Calculated: C, 46.90; H, 2.76; N, 16.41
Found: C, 46.76; H, 2.78; N, 16.29

This compound is referred to hereinafter as Compound 196.

Example CXXI

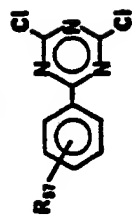
In a manner similar to that employed in Example CXX, other compounds were prepared. The structures and analytical data for Compounds 197

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through 199, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table P below.

TABLE A

Representative Heterocyclic Nitrogen-Containing Compounds



| Compound No. | Substituents R ₅₇ | Elemental Analysis | | | | | | Melting Point (°C) |
|-----------------|---------------------------------|--------------------|------|-------|-------|------|-------|--------------------------|
| | | Calculated | | | Found | | | |
| | | C | H | N | C | H | N | |
| 197 | 4-CH ₃ | 50.03 | 2.94 | 17.50 | 50.58 | 3.17 | 17.36 | 148.0-150.5 |
| 198 | 4-Cl | 41.50 | 1.55 | 16.13 | 41.13 | 1.83 | 16.06 | 150.0-151.0 |
| 199 | 2,4-Cl ₂ | 36.65 | 1.03 | 14.25 | 36.27 | 1.39 | 14.19 | 143.0-145.0 |

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Example CXXIIPreparation of 2-[(2-phenoxy)ethoxy]-4,6-dichloro-1,3,5-triazine

In a manner similar to that employed in Example XXXII, 2-phenoxyethanol was reacted with cyanuric chloride in the presence of 2,6-lutidine as an acid acceptor to give 2-[(2-phenoxy)ethoxy]-4,6-dichloro-1,3,5-triazine having a melting point of 81°C-83°C. Elemental analysis of the product indicated the following:

Analysis: $C_{11}H_9Cl_2N_3O_2$

Calculated: C, 46.17; H, 3.17; N, 14.69

Found: C, 46.41; H, 3.44; N, 14.68

This compound is referred to hereinafter as Compound 200.

Example CXXIIIPreparation of 2-[2-(2,4-dichlorophenoxy)ethoxy]-4,6-dichloro-1,3,5-triazinePart A. Preparation of 2-(2,4-dichlorophenoxy)-ethanol

To a solution of 2.44 grams (0.06 mole) of NaOH in 20 milliliters of water was added 10.0 grams (0.06 mole) of 2,4-dichlorophenol portionwise. A 4.8 milliliter (0.07 mole) portion of 2-bromoethanol was then added and the mixture heated at a temperature of 60°C for a period of approximately 16 hours. After cooling, the reaction mixture was extracted with dichloromethane and the combined organic extracts then washed with 1N NaOH solution and water and then dried over $MgSO_4$. Concentra-

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tion under reduced pressure gave 8.02 grams (0.04 mole) of 2-(2,4-dichlorophenoxy)ethanol. NMR analysis of the phenol intermediate indicated the following: ^1H NMR (CDCl_3): δ 2.73 (m, H), 3.7-4.4 (m, 4H), 6.97 (d, H, $J = 8\text{Hz}$), 7.33 (dd, H, $J = 3, 8\text{Hz}$), 7.47 (d, H, $J = 3\text{Hz}$) ppm.

Part B. Preparation of 2-[2-(2,4-dichlorophenoxy)-ethoxy]-4,6-dichloro-1,3,5-triazine

In a manner similar to that employed in Example XXXII, cyanuric chloride was reacted with 2-(2,4-dichlorophenoxy)ethanol prepared in Part A above in the presence of 2,6-lutidine as an acid acceptor to give 2-[2-(2,4-dichlorophenoxy)ethoxy]-4,6-dichloro-1,3,5-triazine having a melting point of 103°C - 104.5°C . Elemental analysis of the product indicated the following:

Analysis: $\text{C}_{11}\text{H}_7\text{Cl}_4\text{N}_3\text{O}_2$

Calculated: C, 37.21; H, 1.99; N, 11.84

Found: C, 37.06; H, 2.19; N, 11.73

This compound is referred to hereinafter as Compound 201.

Example CXXIV

Preparation of 2-[(2,4-dichlorobenzoyloxy)-ethoxy]-4,6-dichloro-1,3,5-triazine

Part A. Preparation of 2-(2,4-dichlorobenzoyloxy)-ethanol

To a slurry of 125 grams of neutral alumina in 125 milliliters of ether was added 5.0 grams

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(0.03 mole) of 2,4-dichlorobenzyl alcohol and 62.5 milliliters (0.12 mole) of a 2M solution of ethylene oxide in ether. This mixture was stirred for a period of approximately 16 hours at room temperature, poured into 500 milliliters of methanol and allowed to stand for 6 hours. The alumina was filtered off, washed with methanol and the filtrate concentrated under reduced pressure to give 9.26 grams of crude product as a clear liquid. This was combined with 2.6 grams of crude product prepared from a previous identical reaction except that 2.0 grams (0.01 mole) of 2,4-dichlorobenzyl alcohol was used. The combined products were flash-chromatographed using hexane-ethyl acetate (1:1 v/v) as the eluant to give 1.3 grams (0.006 mole) of 2-(2,4-dichlorobenzoyloxy) ethanol as a colorless liquid. NMR analysis of this intermediate indicated the following: ^1H NMR (CDCl_3): δ 2.47 (br s, H), 3.5-4.0 (m, 4H), 4.60 (s, 2H), 7.1-7.6 (m, 3H) ppm.

Part B. Preparation of 2-[(2,4-dichlorobenzoyloxy)-ethoxy]-4,6-dichloro-1,3,5-triazine

In a manner similar to that employed in Example XXXII, cyanuric chloride was reacted with 2-(2,4-dichlorobenzoyloxy)ethanol prepared in Part A above in the presence of 2,6-lutidine as an acid acceptor to give 2-[(2,4-dichlorobenzoyloxy)-ethoxy]-4,6-dichloro-1,3,5-triazine as a colorless oil. Elemental analysis of the product indicated the following:

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Analysis: $C_{12}H_9Cl_4N_3O_2$
Calculated: C, 39.05; H, 2.46; N, 11.39
Found: C, 39.82; H, 2.55; N, 11.32

This compound is referred to hereinafter as Compound 202.

Example CXXV

Preparation of 2-(2-[2-(2,4-dichlorophenoxy)-ethoxy]ethoxy)-4,6-dichloro-1,3,5-triazine

Part A. Preparation of 2-[2-(2,4-dichlorophenoxy)-ethoxy]ethanol

In a manner similar to that employed in Part A of Example CXXIII, 2,4-dichlorophenol was reacted with 2-(2-chloroethoxy)ethanol in the presence of sodium hydroxide as an acid acceptor to give 2-[2-(2,4-dichlorophenoxy)ethoxy]ethanol as a colorless liquid. NMR analysis of this intermediate indicated the following: 1H NMR ($CDCl_3$) δ 2.83 (br s, H), 3.5-4.0 (m, 6H), 4.1-4.4 (m, 2H), 6.83 (d, H, J = 2 Hz), 7.20 (dd, H, J = 2.8 Hz), 7.37 (d, H, J = 2 Hz) ppm.

Part B. Preparation of 2-(2-[2-(2,4-dichlorophenoxy)ethoxy]ethoxy)-4,6-dichloro-1,3,5-triazine

In a manner similar to that employed in Example XXXII, cyanuric chloride was reacted with 2-[2-(2,4-dichlorophenoxy)ethoxy]ethanol prepared in Part A above in the presence of 2,6-lutidine as an acid acceptor to give 2-(2-[2-(2,4-dichlorophenoxy)-

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ethoxy]ethoxy)-4,6-dichloro-1,3,5-triazine having a melting point of 59.5°C-61.5°C. Elemental analysis of the product indicated the following:

Analysis: $C_{13}H_{11}Cl_2N_3O_3$

Calculated: C, 39.12; H, 2.78; N, 10.53

Found: C, 38.65; H, 2.76; N, 10.71

This compound is referred to hereinafter as Compound 203.

Example CXXVI

Preparation of 2-[4-(2,4-dichlorophenyl)butoxy]- 4,6-dichloro-1,3,5-triazine

Part A. Preparation of 2-(2,4-dichlorophenyl) ethyl bromide

A mixture of 30.1 grams (0.16 mole) of 2,4-dichlorophenethyl alcohol prepared in Part A of Example XLVIII and 140 milliliters of 48% aqueous HBr was heated under reflux for a period of 5 hours. After cooling, the reaction mixture was partitioned between ether and water and the ethereal phase then extracted with saturated aqueous $NaHCO_3$, dried over $MgSO_4$ and concentrated under reduced pressure to give a brown liquid. Kugelrohr distillation gave 29.7 grams (0.12 mole) of 2-(2,4-dichloro-phenyl)ethyl bromide as a colorless liquid having a boiling point of 70°C at 0.025 mm Hg. NMR analysis of this intermediate indicated the following: 1H NMR ($CDCl_3$) δ 3.0-3.8 (m, 4H), 7.0-7.4 (m, 3H) ppm.

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Part B. Preparation of 4-(2,4-dichlorophenyl)-
butan-1-ol

To 0.96 grams (0.04 mole) of magnesium turnings in 20 milliliters of anhydrous tetrahydrofuran was added dropwise a solution of 2-(2,4-dichloro-phenyl)ethyl bromide prepared in Part A above in 30 milliliters of tetrahydrofuran. When the magnesium had been consumed, the yellow solution of Grignard reagent was added dropwise to a cold (-30°C) mixture of 1.9 grams (0.01 mole) of curpous iodide in 30 milliliters of tetrahydrofuran. This mixture was stirred for a period of 5 minutes and 35 milliliters of tetrahydrofuran was added. This mixture was stirred for a period of 5 minutes and 35 milliliters (0.07 mole) of a 2M solution of ethylene oxide was then added dropwise. The reaction mixture was stirred for a period of 2 hours at a temperature of 0°C and a 1 hour period at room temperature and then quenched with 50 milliliters of water. The volume was reduced in vacuo and the residue extracted with ether. The ethereal layer was dried (MgSO_4) and concentrated under reduced pressure to give a liquid which was chromatographed on silica gel to give 2.37 grams (0.01 mole) of 4-(2,4-dichlorophenyl)butan-1-ol as a pale yellow liquid. NMR analysis of this intermediate indicated the following: ^1H NMR (CDCl_3) δ 1.43-1.83 (m, 4H), 2.53-2.90 (m, 3H), 3.50-3.77 (m, 2H), 7.07 (m, 2H), 7.33 (m, H) ppm.

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Part C. Preparation of 2-[4-(2,4-dichlorophenyl)-
butoxy]-4,6-dichloro-1,3,5-triazine

In a manner similar to that employed in Example XXXII, cyanuric chloride was reacted with 4-(2,4-dichlorophenyl)butan-1-ol prepared in Part B above in the presence of 2,6-lutidine as an acid acceptor to give 2-[4-(2,4-dichlorophenyl)butoxy]-4,6-dichloro-1,3,5-triazine as a pale yellow oil. Elemental analysis of the product indicated the following:

Analysis: $C_{13}H_{11}Cl_4N_3O$
Calculated: C, 42.53; H, 3.02; N, 11.45
Found: C, 43.30; H, 3.08; N, 10.76

This compound is referred to hereinafter as Compound 204.

Example CXXVII

Preparation of 2,4-dichloro-6-(2,4-dichloro-
3,5-dimethylphenoxy)-1,3,5-triazine

In a manner similar to that employed in Example I, cyanuric chloride was reacted with 2,4-dichloro-3,5-dimethylphenol in the presence of 2,6-lutidine as an acid acceptor to give 2,4-dichloro-6-(2,4-dichloro-3,5-dimethylphenoxy)-1,3,5-triazine having a melting point of 118°C-120°C. Elemental analysis of the product indicated the following:

Analysis: $C_{11}H_7Cl_4N_3O$
Calculated: C, 38.97; H, 2.08; N, 12.39
Found: C, 39.18; H, 2.25; N, 12.47

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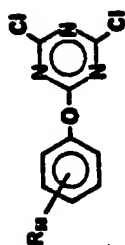
This compound is referred to hereinafter as Compound 205.

Example CXXVIII

In a manner similar to that employed in Example CXXVII, other compounds were prepared. The structures and analytical data for Compounds 206 through 210, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table Q below.

TABLE Q

Representative Heterocyclic Nitrogen-Containing Compounds



| Compound No. | Substituents R ₅₈ | Elemental Analysis | | | | Melting Point (°C) |
|--------------|---------------------------------|--|------|-------|------|--------------------|
| | | Calculated | | Found | | |
| | | C | H | C | H | |
| 206 | 2,3,4,5,6-F ₅ | 32.56 | -- | 32.72 | -- | 88-90 |
| 207 | 3-CH ₃ | 38.73 | 1.30 | 39.12 | 1.36 | 88-90 |
| 208 | 2,4-F ₂ | IR (KBr)1490, 1400, 1290, 1245, 1190, 1140, 1000, 960, 840, 795 cm ⁻¹ | | | | 98-101 |
| 209 | 2-Cl-4-NO ₂ | 33.62 | 0.94 | 33.88 | 1.08 | 131-133 |
| 210 | 4-H ₂ N-C(=O) O | 42.13 | 2.12 | 42.71 | 2.67 | 189-191 |

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Example CXXIXPreparation of acetone O-(4,6-dichloro-1,3,5-triazin-2-yl)oxime

In a manner similar to that employed in Example XXXVI, cyanuric chloride was reacted with acetone oxime in the presence of sodium bicarbonate as an acid acceptor to give acetone O-(4,6-dichloro-1,3,5-triazin-2-yl)oxime having a melting point of 60°C-62°C. Elemental analysis of the product indicated the following:

Analysis: $\text{C}_6\text{H}_6\text{Cl}_2\text{N}_4\text{O}$

Calculated: C, 32.60; H, 2.74; N, 25.35

Found: C, 32.24; H, 2.90; N, 25.28

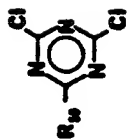
This compound is referred to hereinafter as Compound 211.

Example CXXX

In a manner similar to that employed in Example LXXIII, other compounds were prepared. The structures and analytical data for Compounds 212 and 213, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table R below.

TABLE B

Representative Heterocyclic Nitrogen-containing Compounds



| Compound No. | Substituents | Elemental Analysis | | | | | | Melting Point (°C) |
|-----------------|--|--------------------|------|-------|-------|------|-------|--------------------------|
| | | Calculated | | | Found | | | |
| | | C | H | N | C | H | N | |
| 212 | CH ₃ CH ₂ CH ₂ C≡C- | 44.47 | 3.27 | 19.45 | 40.13 | 2.72 | 19.47 | 011 |
| 213 | (CH ₃) ₃ CC≡C- | 46.98 | 3.94 | 18.26 | 47.86 | 4.21 | 17.41 | 011 |

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Example CXXXIPreparation of 2-chloro-4-ethynyl-6-methoxy-
1,3,5-triazine

To 1.0 gram (0.004 mole) of 2,4-dichloro-6-trimethylsilylethynyl-1,3,5-triazine prepared in Example LXXII in methanol solution was added 0.235 gram (0.004 mole) of potassium fluoride at a temperature of 0°C. The reaction mixture was stirred for a period of 30 minutes, a saturated aqueous solution of ammonium chloride was added and the methanol then evaporated in vacuo. The residue was extracted with ether and the ether solution was dried over Na_2SO_4 , filtered and evaporated to give 0.33 gram (0.002 mole) of 2-chloro-4-ethynyl-6-methoxy-1,3,5-triazine having a melting point of 108°C-110°C. Elemental analysis of the product indicated the following:

Analysis: $\text{C}_6\text{H}_4\text{ClN}_3\text{O}$

Calculated: C, 42.50; H, 2.38; N, 24.78

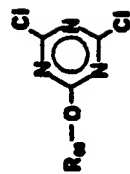
Found: C, 41.58; H, 2.29; N, 23.91

This compound is referred to hereinafter as Compound 214.

Example CXXXII

In a manner similar to that employed in Example LXI, other compounds were prepared. The structures and analytical data for Compounds 215 through 217, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table S below.

TABLE S
Representative Heterocyclic Nitrogen-Containing Compounds



| Compound No. | Substituents R ₆ O | Elemental Analysis | | | | Melting Point (°C) |
|--------------|----------------------------------|--------------------|------|-------|-------|--------------------|
| | | Calculated | | Found | | |
| | | C | H | C | H | |
| 215 | | 42.05 | 2.35 | 21.79 | 39.68 | 19.60 |
| | | | | | | 160-162 (dec) |
| 216 | | 41.79 | 2.23 | 13.29 | 41.14 | 13.77 |
| | | | | | | 110-138 |
| 217 | | 53.50 | 2.25 | 15.60 | 53.46 | 15.48 |
| | | | | | | 110-120 |

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Example CXXXIIIPreparation of 2,4-dichloro-6-phenylsulfonamido-1,3,5-triazine

In a manner similar to that employed in Example LXXIV, cyanuric chloride was reacted with benzenesulfonamide in the presence of sodium hydroxide as an acid acceptor to give 2,4-dichloro-6-phenylsulfonamido-1,3,5-triazine having a melting point of 185°C-186°C. Elemental analysis of the product indicated the following:

Analysis: $C_9H_6Cl_2N_4O_2S$

Calculated: C, 35.42; H, 1.98; N, 18.36

Found: C, 35.04; H, 2.32; N, 18.09

This compound is referred to hereinafter as Compound 218.

Example CXXXIVPreparation of 2-chloro-4-(2,4-dichlorophenoxy)-6-hexafluoroisopropoxy-1,3,5-triazine

To a solution of 5.0 grams (0.02 mole) of 2,4-dichloro-6-(2,4-dichlorophenoxy)-1,3,5-triazine prepared in Example IV in 100 milliliters of acetone was added at a temperature of 40°C a solution of 1.9 milliliters (0.02 mole) of 2,6-lutidine in 75 milliliters of acetone followed by a solution of 1.9 milliliters (0.02 mole) of hexafluoroisopropyl alcohol in 75 milliliters of acetone. The resulting mixture was heated under reflux for a period of 10 hours and then evaporated to dryness in vacuo. The residue was subjected to flash column chromatography on silica gel by first eluting with 5% ethyl acetate

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in hexane and then with 15% dichloromethane in hexane to give 1.34 grams (0.0035 mole) of 2-chloro-4-(2,4-dichlorophenoxy)-6-hexafluoroisopropoxy-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

Analysis: $C_{12}H_4Cl_3F_6N_3O_2$
Calculated: C, 37.38; H, 1.05; N, 10.90
Found: C, 32.52; H, 0.89; N, 9.48

This compound is referred to hereinafter as Compound 219.

Example CXXXV

Preparation of 2-chloro-4-(1-naphthoxy)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazine

In a manner similar to that employed in Example CXXXIV, 2,4-dichloro-6-(1-naphthoxy)-1,3,5-triazine prepared in Example IX was reacted with 2,2,2-trifluoroethanol in the presence of 2,6-lutidine as an acid acceptor to give 2-chloro-4-(1-naphthoxy)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

Analysis: $C_{15}H_{19}ClFN_3O_2$
Calculated: C, 50.65; H, 2.55; N, 11.81
Found: C, 51.04; H, 2.75; N, 11.53

This compound is referred to hereinafter as Compound 220.

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Example CXXXVIPreparation of 2-chloro-4-(2,4-dichlorophenoxy)-
6-ethoxy-1,3,5-triazine

To a suspension of 0.39 gram (0.02 mole) of magnesium in 70 milliliters of dry tetrahydrofuran was added a solution of 3.17 grams (0.02 mole) of bromoacetaldehyde diethyl acetal in 10 milliliters of dry tetrahydrofuran. The resulting mixture was stirred at room temperature for a period of 1 hour and a solution of 5.0 grams (0.02 mole) of 2,4-dichloro-6-(2,4-dichlorophenoxy)-1,3,5-triazine was then added dropwise. The reaction mixture was stirred at room temperature for a period of approximately 16 hours, evaporated to dryness and the residue purified by flash-column chromatography on silica gel by eluting with 5% ethyl acetate in hexane to give 1.9 grams (0.01 mole) of 2-chloro-4-(2,4-dichlorophenoxy)-6-ethoxy-1,3,5-triazine as an oil. Elemental analysis of the product indicated the following:

Analysis: $C_{11}H_8Cl_3N_3O_2$

Calculated: C, 41.22; H, 2.51; N, 13.11

Found: C, 41.24; H, 2.50; N, 12.75

This compound is referred to hereinafter as Compound 221.

Example CXXXVIIPreparation of 2,4-dichloro-6-(2,2,2-trichloroethoxy)-1,3,5-triazine

To a solution of 5.0 grams (0.03 mole) of cyanuric chloride in 100 milliliters of acetone was..

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added at a temperature of 4°C a solution of 3.16 milliliters (0.03 mole) of 2,6-lutidine followed by a solution of 2.60 milliliters (0.03 mole) of 2,2,2-trichloroethanol in 150 milliliters of acetone. The mixture was stirred at room temperature for a period of about 16 hours and the solvent was removed by evaporation. The residue was partitioned between water and dichloromethane, the organic layer dried over anhydrous sodium sulfate and the residue, following evaporation of solvents, purified by flash column chromatography on silica gel. Elution by ethyl acetate-hexane gave 1.1 grams (0.004 mole) of 2,4-dichloro-6-(2,2,2-trichloroethoxy)-1,3,5-triazine as yellow crystals having a melting point of 72°C-73°C. Elemental analysis of the product indicated the following:

Analysis: $C_5H_2Cl_5N_3O$

Calculated: C, 20.20; H, 0.68; N, 14.13

Found: C, 20.19; H, 0.68; N, 14.48

This compound is referred to hereinafter as Compound 222.

Example CXXXVIII

Preparation of 2,4-dichloro-6-[2-(N-methylpyrrolyl)]-1,3,5-triazine-

A mixture of 2.4 milliliters (0.03 mole) of N-methylpyrrole, 5.0 grams (0.03 mole) of cyanuric chloride and 50 milliliters of p-dioxane was heated under reflux for a period of 5 hours. The reaction mixture was poured into water and the precipitate which formed was collected by suction filtration and

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dried. Crystallization from hexane gave 2.0 grams (0.01 mole) of 2,4-dichloro-6-[2-(N-methylpyrrolyl)]-1,3,5-triazine as pale yellow crystals having a melting point of 153°C-154°C. Elemental analysis of the product indicated the following:

Analysis: $C_8H_6Cl_2N_4$

Calculated: C, 41.95; H, 2.64; N, 24.46

Found: C, 42.00; H, 2.73; N, 24.46

This compound is referred to hereinafter as Compound 223.

Example CXXXIX

Preparation of N-(4,6-dichloro-1,3,5-triazin-2-yl)-2-oxohexamethyleneimine

To a suspension of 10.0 grams (0.09 mole) of potassium hydride in oil was added 200 milliliters of dry tetrahydrofuran at a temperature of -60°C followed by the addition of 10.0 grams (0.09 mole) of ϵ -caprolactam at the same temperature. The mixture was warmed to room temperature and stirred for a period of one hour after which a solution of 16.3 grams (0.09 mole) of cyanuric chloride in 100 milliliters of tetrahydrofuran was added and stirring continued for an additional two hour period. The reaction mixture was vacuum evaporated and the residue purified by flash chromatography to give 1.2 grams (0.005 mole) of N-(4,6-dichloro-1,3,5-triazin-2-yl)-2-oxohexamethyleneimine as an oil. Elemental analysis of the product indicated the following:

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Analysis: $C_9H_{10}Cl_2N_4O$

Calculated: C, 41.40; H, 3.86; N, 21.46

Found: C, 40.85; H, 4.40; N, 21.01

This compound is referred to hereinafter as Compound 224.

Example CXL

Preparation of N-(4,6-dichloro-1,3,5-triazin-2-yl)-2-oxotetramethyleneimine

In a manner similar to that employed in Example CXXXIX, 2-pyrrolidinone was treated with potassium hydride and the resulting potassium salt was then reacted with cyanuric chloride to give N-(4,6-dichloro-1,3,5-triazin-2-yl)-2-oxotetramethyleneimine having a melting point of 192°C-194°C. Elemental analysis of the product indicated the following:

Analysis: $C_7H_6Cl_2N_4O$

Calculated: C, 36.07; H, 2.60; N, 24.04

Found: C, 35.86; H, 2.54; N, 24.01

This compound is referred to hereinafter as Compound 225.

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Example CXLI

Preparation of N-(4,6-dichloro-1,3,5-triazin-2-yl)-1,3,3-trimethyl-6-aza-bicyclo [3.2.1]octane
and 2,4-bis(1,3,3-trimethyl-6-azabicyclo
[3.2.1] octan-6-yl)-6-chloro-1,3,5-triazine

In a manner similar to that employed in Example CXXXIX, 1,3,3-trimethyl-6-azabicyclo [3.2.1] octane was treated with potassium hydride and the resulting potassium salt was then reacted with cyanuric chloride to give N-(4,6-dichloro-1,3,5-triazin-2-yl)-1,3,3-trimethyl-6-azabicyclo [3.2.1] octane having a melting point of 133°C-135°C and 2,4-bis(1,3,3-trimethyl-6-azabicyclo [3.2.1] octan-6-yl)-6-chloro-1,3,5-triazine having a melting point of 161.5°C-163°C by separating the two products by flash column chromatography. Elemental and NMR analysis of the two products indicated the following:

N-(4,6-dichloro-1,3,5-triazin-2-yl)-1,3,3-
trimethyl-6-azabicyclo [3.2.1] octane

| | |
|-------------|---|
| Analysis: | $C_{12}H_{18}Cl_2N_3$ |
| Calculated: | C, 51.83; H, 6.02; N, 18.60; Cl, 23.54 |
| Found: | C, 51.82; H, 5.81; N, 18.47; Cl, 23.78 |

This compound is referred to hereinafter as Compound 226.

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2,4-Bis(1,3,3-trimethyl-6-azabicyclo[3.2.1]octan-6-yl)-6-chloro-1,3,5-triazine

¹H NMR (CDCl₃): δ 0.80 (s, 6H), 0.94 (s, 6H), 1.10 (s, 6H), 1.30-2.30 (m, 12H), 2.90-3.70 (m, 4H), 4.30-4.68 (m, 2H) ppm.

This compound is referred to hereinafter as Compound 227.

Example CXLII

Preparation of 4,6-dichloro-2-(3-phenylphenoxy)-1,3,5-triazine

In a manner similar to that employed in Example X, cyanuric chloride was reacted with 3-phenylphenol in the presence of triisopropanolamine as an acid acceptor to give 4,6-dichloro-2-(3-phenylphenoxy)-1,3,5-triazine having a melting point of 183°C-185°C. Elemental analysis of the product indicated the following:

| | |
|-------------|---|
| Analysis: | C ₁₅ H ₉ N ₃ O |
| Calculated: | C, 56.63; H, 2.85; N, 13.21; Cl, 22.29 |
| Found: | C, 56.33; H, 3.29; N, 13.15; Cl, 21.55 |

This compound is referred to hereinafter as Compound 228.

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Example CXLIIIPreparation of 2,3-dichloro-N-(2-chloroanilino)-
maleimide

A stirred mixture of 5.0 grams (0.03 mole) of o-chlorophenylhydrazine hydrochloride, 4.7 grams (0.03 mole) of dichloromaleic anhydride and 20 milliliters of acetic acid was heated at a temperature of 100°C for a period of 45 minutes. The mixture was cooled to room temperature and water was added dropwise causing a precipitate to form. The first crop of product was filtered off and a second crop was obtained by slow evaporation of the mother liquor and a second filtration. Combining the two crops gave 5.55 grams (0.02 mole) of 2,3-dichloro-N-(2-chloroanilino)maleimide as yellow crystals having a melting point of 137°C-138°C. Elemental analysis of the product indicated the following:

Analysis: $C_{10}H_5Cl_3N_2O_2$

Calculated: C, 41.20; H, 1.73; N, 9.61

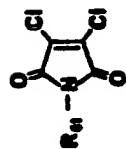
Found: C, 40.80; H, 1.97; N, 9.75

This compound is referred to hereinafter as Compound 229.

Example CXLIV

In a manner similar to that employed in Example CXLIII, other compounds were prepared. The structures and analytical data for Compounds 230 through 250, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table T below.

TABLE I
Representative Heterocyclic Nitrogen-Containing Compounds





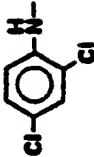
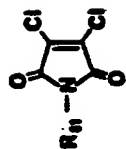
| Compound No. | Substituents R ₅₁ | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|---|--------------------|------|-------|------|-------|-----------|--------------------|
| | | Calculated | | Found | | N | | |
| | | C | H | C | H | | | |
| 230 |  | 46.72 | 2.35 | 46.69 | 2.36 | 10.79 | 166-182 | |
| 231 |  | 41.20 | 1.73 | 40.68 | 1.73 | 9.34 | 173-174 | |
| 232 |  | 36.85 | 1.24 | 36.68 | 1.40 | 8.47 | 184.5-185 | |

TABLE I (cont.)
Representative Heterocyclic Nitrogen-Containing Compounds



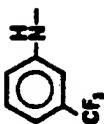
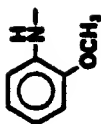
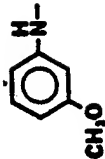
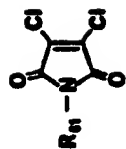
| Compound No. | Substituents R ₆₁ | Elemental Analysis | | | | Melting Point (°C) | |
|-----------------|---|--------------------|------|-------|------|--------------------------|-----------|
| | | Calculated | | Found | | | |
| | | C | H | C | H | | |
| 233 |  | 40.64 | 1.55 | 40.73 | 1.63 | 8.62 | 174.5-175 |
| 234 |  | 46.02 | 2.81 | 46.06 | 2.82 | 9.78 | 136-138 |
| 235 |  | 46.02 | 2.81 | 46.08 | 2.71 | 9.66 | 126-128 |

TABLE I (Cont.)
Representative Heterocyclic Nitrogen-Containing Compounds



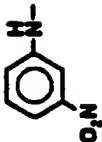

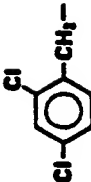
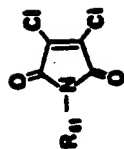
| Compound No. | Substituents R ₆₁ | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|---|--------------------|------|-------|-------|------|-------|--------------------|
| | | Calculated | | | Found | | | |
| | | C | H | N | C | H | N | |
| 236 |  | 39.76 | 1.67 | 13.91 | 39.66 | 1.69 | 13.86 | 183-185 |
| 237 |  | 51.59 | 2.76 | 5.47 | 51.79 | 2.86 | 5.44 | 107-109 |
| 238 |  | 40.65 | 1.55 | 4.31 | 40.65 | 1.63 | 4.48 | 142.5-144 |

TABLE I (Cont.)
Representative Heterocyclic Nitrogen-Containing Compounds






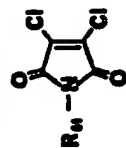
| Compound No. | Substituents R ₆₁ | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|---|--------------------|------|-------|-------|------|------|--------------------|
| | | Calculated | | Found | | C | H | |
| | | C | H | C | H | | | |
| 239 |  | 45.47 | 2.08 | 4.82 | 45.83 | 2.22 | 4.58 | 108-110.5 |
| 240 |  | 50.38 | 3.17 | 4.90 | 49.69 | 3.57 | 4.69 | 101-102 |
| 241 |  | 56.39 | 4.39 | 4.70 | 55.94 | 4.38 | 4.71 | 70-71 |

TABLE I (Cont.)
Representative Heterocyclic Nitrogen-Containing Compounds






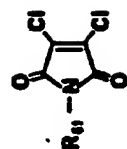



| Compound No. | Substituents R ₅₁ | Elemental Analysis | | | | | | Melting Point (°C) |
|-----------------|---|--------------------|------|------|-------|------|------|--------------------------|
| | | Calculated | | | Found | | | |
| | | C | H | N | C | H | N | |
| 242 |  | 50.55 | 3.53 | 9.82 | 50.34 | 3.66 | 9.70 | 140.5-141.5 |
| 243 |  | 53.56 | 3.36 | 5.19 | 53.49 | 3.47 | 5.19 | 011 |
| 244 |  | 53.36 | 3.36 | 5.19 | 53.58 | 3.30 | 5.14 | 131-132 |

TABLE I (Cont.)
Representative Heterocyclic Nitrogen-containing Compounds

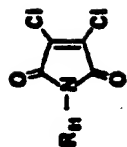





| Compound No. | Substituents | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|---|--------------------|------|------|-------|------|------|--------------------|
| | | Calculated | | | Found | | | |
| | | C | H | N | C | H | N | |
| 245 |  | 43.93 | 2.05 | 5.69 | 44.16 | 2.21 | 5.76 | 55-56 |
| 246 |  | 46.18 | 3.88 | 5.98 | 45.64 | 3.91 | 6.25 | 66.5-67 |
| 247 |  | 48.41 | 4.47 | 5.65 | 48.36 | 4.51 | 5.31 | 138-140 |

4

5

TABLE I (Cont.)
Representative Heterocyclic Nitrogen-Containing Compounds



| Compound No. | Substituents | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|---|--------------------|------|------|-------|------|------|--------------------|
| | | Calculated | | | Found | | | |
| | | C | H | N | C | H | N | |
| 248 |  | 40.81 | 2.45 | 6.80 | 41.03 | 2.49 | 6.68 | 118.5-120 |
| 249 |  | 46.34 | 2.12 | 9.82 | 46.33 | 2.11 | 9.84 | 227-229 |
| 250 |  | 37.40 | 1.88 | 8.72 | 37.36 | 1.80 | 8.78 | 186.5-189 |

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Example CXLVPreparation of 6-hydroxy-2-phenyl-
3(2H)pyridazinone

A stirred mixture of 10 milliliters (0.10 mole) of phenylhydrazine, 10 grams (0.10 mole) of maleic anhydride and 75 milliliters of acetic acid was heated under reflux for a period of 6 hours. The mixture was cooled to room temperature causing separation of crystals which were filtered off giving 10.62 grams (0.05 mole) of 6-hydroxy-2-phenyl-3(2H)pyridazinone as yellow crystals having a melting point of 262°C (decomposition). NMR analysis indicated the following: ¹H NMR (CDCl₃): δ 7.21 (AB_q, 2H, J = 10 Hz), 7.50-7.87 (m, 5H) ppm.

This compound is referred to hereinafter as Compound 251.

Example CXLVIPreparation of 4,6-dichloro-2-phenyl-
3(2H)pyridazinone

A stirred mixture of 30 milliliters (0.32 mole) of phosphorus oxychloride, 30 grams (0.14 mole) of phosphorus pentachloride and 5.0 grams (0.024 mole) of 6-hydroxy-2-phenyl-3(2H)pyridazinone prepared in Example CXLV was heated at a temperature of 160°C-170°C for a period of 90 minutes. The mixture was cooled to room temperature and poured into ice water giving a yellow precipitate. The crude product was filtered off and crystallized from methylene chloride-hexane to give

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2.1 grams (0.01 mole) of 4,6-dichloro-2-phenyl-3(2H)-pyridazinone as yellow crystals having a melting point of 110°C-111°C. Elemental analysis of the product indicated the following:

Analysis: $C_{10}H_6Cl_2N_2O$

Calculated: C, 49.33; H, 2.56; N, 11.18

Found: C, 49.69; H, 2.61; N, 11.57

This compound is referred to hereinafter as Compound 252.

Example CXLVII

Preparation of 6-chloro-2-phenyl-3(2H)pyridazinone

A stirred mixture of 2.0 grams (0.01 mole) of 6-hydroxy-2-phenyl-3-(2H)pyridazinone prepared in Example CXLV and 20 milliliters (0.21 mole) of phosphorus oxychloride was heated at a temperature of 95°C for a period of 2 hours. The reaction mixture was cooled to room temperature and then quenched with ice water. Hexane was added and the mixture was triturated giving white crystals. These crystals were filtered off to give 0.81 gram (0.004 mole) of 6-chloro-2-phenyl-3(2H)pyridazinone as off-white crystals having a melting point of 112°C-113°C. Elemental analysis of the product indicated the following:

Analysis: $C_{10}H_7ClN_2O$

Calculated: C, 58.13; H, 3.42; N, 13.56;
Cl, 17.16

Found: C, 58.10; H, 3.10; N, 13.41;
Cl, 16.47

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This compound is referred to hereinafter as Compound 253.

Example CXLVIII

Preparation of 4,5-dichloro-6-hydroxy-2-(2,4-dichlorophenyl)-3(2H)pyridazinone

Into a mixture of 18.8 grams (0.09 mole) of 2,4-dichlorophenylhydrazine hydrochloride and 600 milliliters of 6N hydrochloric acid was added 14.7 grams (0.09 mole) of dichloromaleic anhydride. The mixture was heated under reflux for a period of 6 hours and the resulting solid was filtered off and washed with ice water and hexane to give 7.6 grams (0.023 mole) of 4,5-dichloro-6-hydroxy-2-(2,4-dichlorophenyl)-3(2H)pyridazinone having a melting point of 295°C-298°C (decomposition). Elemental analysis of the product indicated the following:

Analysis: $C_{10}H_4Cl_4N_2O_2$

Calculated: C, 36.85; H, 1.24; N, 8.59

Found: C, 36.69; H, 1.37; N, 8.44

This compound is referred to hereinafter as Compound 254.

Example CXLIX

Preparation of 4,5-dichloro-6-hydroxy-2-(2-chlorophenyl)-3(2H)pyridazinone

In a manner similar to that employed in Example CXLVIII, o-chloro-phenylhydrazine hydrochloride was reacted with dichloromaleic

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anhydride to give 4,5-dichloro-6-hydroxy-2-(2-chlorophenyl)-3(2H)pyridazinone having a melting point of 242°C-244°C. Elemental analysis of the product indicated the following:

Analysis: $C_{10}H_5Cl_3N_2O_2$
Calculated: C, 41.20; H, 1.73; N, 9.61
Found: C, 41.19; H, 1.97; N, 9.60

This compound is referred to hereinafter as Compound 255.

Example CL

Preparation of 4,5-dichloro-6-hydroxy-2-(3,4-dichlorophenyl)-3(2H)pyridazinone

A stirred mixture of 7.5 grams (0.03 mole) of 3,4-diphenylhydrazine hydrochloride, 5.0 grams (0.3 mole) of dichloromaleic anhydride and 100 milliliters of glacial acetic acid was heated under reflux for a period of 2 days. The mixture was cooled to room temperature causing yellow-orange crystals to separate. Suction filtration of the crystals gave 2.87 grams (0.01 mole) of 4,5-dichloro-6-hydroxy-2-(3,4-dichlorophenyl)-3(2H)-pyridazinone having a melting point of 241°C-242.5°C. Elemental analysis of the product indicated the following:

Analysis: $C_{10}H_4Cl_4N_2O_2$
Calculated: C, 36.85; H, 1.24; N, 8.59
Found: C, 36.47; H, 2.07; N, 7.49

This compound is referred to hereinafter as Compound 256.

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Example CLIPreparation of 2,3-dichloro-N-(2-methylanilino)-maleimide and 4,5-dichloro-6-hydroxy-2-(2-methylphenyl)-3(2H)pyridazinone

In a manner similar to that employed in Example CXLIII, o-tolylhydrazine hydrochloride was reacted with dichloromaleic anhydride to give 2,3-dichloro-N-(2-methylanilino)maleimide having a melting point of 146°C-149°C and 4,5-dichloro-6-hydroxy-2-(2-methylphenyl)-3(2H)pyridazinone having a melting point of 234°C-235.5°C by separating the two products by recrystallization from methylene chloride. Elemental analysis of these two products indicated the following:

2,3-dichloro-N-(2-methylanilino)maleimide

Analysis: $C_{11}H_8Cl_2N_2O_2$
Calculated: C, 48.73; H, 2.97; N, 10.33
Found: C, 48.64; H, 3.12; N, 10.23

This compound is referred to hereinafter as Compound 257.

4,5-dichloro-6-hydroxy-2-(2-methylphenyl)-3(2H)pyridazinone

Analysis: $C_{11}H_8Cl_2N_2O_2$
Calculated: C, 48.73; H, 2.97; N, 10.33
Found: C, 48.29; H, 3.06; N, 10.16

This compound is referred to hereinafter as Compound 258.

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Example CLIIPreparation of 4,5,6-trichloro-2-(2,4-dichlorophenyl)-3(2H)pyridazinone

A stirred mixture of 3.7 grams (0.02 mole) of phosphorus pentachloride, 37 milliliters (0.4 mole) of phosphorus oxychloride and 7.6 grams (0.023 mole) of 4,5-dichloro-6-hydroxy-2-(2,4-dichlorophenyl)-3(2H)pyridazinone prepared in Example CXLVIII was heated at a temperature of 160°C-170°C for a period of 14 hours. The mixture was cooled to room temperature and poured into ice water with addition of a small amount of hexane and stirring to promote precipitation. The crude product was filtered, washed with ice water and purified by flash chromatography on silica gel by eluting with 5% ethyl acetate in hexane to give 0.85 gram (0.0025 mole) of 4,5,6-trichloro-2-(2,4-dichlorophenyl)-3(2H)pyridazinone having a melting point of 154°C-155.5°C. Elemental analysis of the product indicated the following:

Analysis: $C_{10}H_3Cl_5N_2O$

Calculated: C, 34.88; H, 0.88; N, 8.13

Found: C, 34.30; H, 0.96; N, 8.20

This compound is referred to hereinafter as Compound 259.

Example CLIII

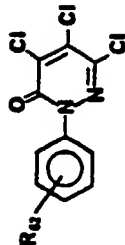
In a manner similar to that employed in Example CLII, other compounds were prepared. The structure and analytical data for Compounds 260

-500-

through 264, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table U below.

TABLE U

Representative Heterocyclic Nitrogen-Containing Compounds



| Compound No. | Substituents R ₆₂ | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|---------------------------------|--------------------|------|-------|-------|------|-------|--------------------|
| | | Calculated | | | Found | | | |
| | | C | H | N | C | H | N | |
| 260 | H | 43.59 | 1.83 | 10.17 | 43.33 | 1.81 | 10.01 | 109-110 |
| 261 | 2-CH ₃ | 45.63 | 2.44 | 9.67 | 45.63 | 2.53 | 9.12 | 130-132 |
| 262 | 2-Cl | 38.75 | 1.30 | 9.04 | 38.89 | 1.39 | 8.79 | 150-152 |
| 263 | 3,4-Cl ₂ | 34.88 | 0.88 | 8.13 | 36.34 | 1.23 | 8.30 | 150-154 |
| 264 | 3-CF ₃ | 38.46 | 1.17 | 8.15 | 38.50 | 1.14 | 8.06 | 109-110 |

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Example CLIVPreparation of 2,3-dimethyl-N-(2-chloroanilino)-maleimide

A stirred mixture of 7.1 grams (0.04 mole) of o-chlorophenylhydrazine hydrochloride, 5.0 grams (0.04 mole) of 2,3-dimethylmaleic anhydride and 25 milliliters of acetic acid was heated at a temperature of 100°C for a period of 1 hour. The reaction mixture was cooled to room temperature and water was added dropwise causing a precipitate to form. The precipitate was filtered off and the filtrate was cooled causing the crude product to separate as a solid. The solid was crystallized from methylene chloride-hexane to give 2.3 grams (0.01 mole) of 2,3-dimethyl-N-(2-chloroanilino)-maleimide as orange crystals having a melting point of 115°C-117.5°C. Elemental analysis of the product indicated the following:

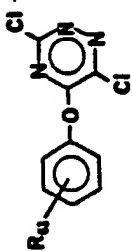
| | |
|-------------|-----------------------------|
| Analysis: | $C_{12}H_{11}ClN_2O_2$ |
| Calculated: | C, 57.49; H, 4.42; N, 11.17 |
| Found: | C, 57.49; H, 4.32; N, 11.15 |

This compound is referred to hereinafter as Compound 265.

Example CLV

In a manner similar to that employed in Part B of Example LXXXIII, other compounds were prepared. The structures and analytical data for Compounds 266 and 267, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table V below.

TABLE V
Representative Heterocyclic Nitrogen-Containing Compounds



| Compound No. | Substituents | Elemental Analysis | | | | | | Melting Point (°C) |
|-----------------|--------------------|--------------------|------|-------|-------|------|-------|--------------------------|
| | | Calculated | | | Found | | | |
| | | C | H | N | C | H | N | |
| 266 | 2,4-F ₂ | 38.68 | 1.08 | 15.11 | 38.87 | 1.37 | 15.03 | 89-91 |
| 267 | 2,3-(CH-CHCH-CH)- | 53.45 | 2.42 | 14.38 | 53.65 | 2.83 | 14.66 | 135-137 |

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Example CLVIPreparation of N-Hydroxymaleimide

N-Hydroxymaleimide having a melting point of 133°C-135°C was purchased from the Aldrich Chemical Company and used without further purification. A log P determination for the product indicated the following: Octanol/Water Log P by Reversed Phase HPLC 0.00.

This compound is referred to hereinafter as Compound 268.

Example CLVIIPreparation of 4,5-dichloro-6-hydroxy-2-(3-trifluoromethylphenyl)-3(2H)pyridazinone

In a manner similar to that employed in Example CXLVIII, m-trifluoro-methylphenylhydrazine hydrochloride was reacted with dichloromaleic anhydride to give 4,5-dichloro-6-hydroxy-2-(3-trifluoromethylphenyl)-3(2H)pyridazinone having a melting point of 171°C-172°C. Elemental analysis of the product indicated the following:

Analysis: $C_{11}H_5Cl_2F_3N_2O_2$
Calculated: C, 40.64; H, 1.55; N, 8.62
Found: C, 40.55; H, 1.50; N, 8.61

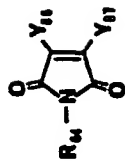
This compound is referred to hereinafter as Compound 269.

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Example CLVIII

In a manner similar to that employed in Example CXLIII, other compounds were prepared. The structures and analytical data for Compounds 270 through 275, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table W below.

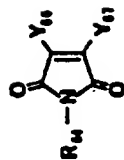
TABLE M
Representative Heterocyclic Nitrogen-Containing Compounds



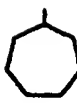


| Compound No. | Substituents | | | Elemental Analysis | | | | Melting Point (°C) |
|-----------------|--------------|-----|-----|--------------------|-------|-------|------|--------------------------|
| | R64 | Y66 | Y67 | Calculated | Found | C | H | |
| 270 | | Cl | Cl | 48.21 | 2.94 | 48.05 | 2.28 | 92-93.5 |
| 271 | | Cl | Cl | 48.21 | 2.94 | 48.14 | 2.28 | 72-73 |
| 272 | | H | Br | 49.65 | 3.03 | 49.73 | 3.03 | 51-52 |

**

TABLE W (Cont.)
Representative Heterocyclic Nitrogen-Containing Compounds



| Compound No. | Substituents | | | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|---|-----|-----|--------------------|------|-------|------|------|-----------|--------------------|
| | R64 | Y66 | Y67 | Calculated | | Found | | | | |
| | | | | C | H | C | H | N | | |
| 273 |  | Cl | Cl | 48.21 | 2.94 | 47.98 | 2.29 | 5.05 | 115-116 | |
| 274 |  | Cl | Cl | 41.24 | 1.92 | 41.37 | 2.06 | 5.22 | 86.5-88 | |
| 275 |  | Cl | Cl | 50.40 | 5.00 | 50.65 | 4.98 | 5.30 | 109-110.5 | |

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Example CLIXPreparation of 2-methyl-4,5,6-trichloro-
3(2H)pyridazinonePart A. Preparation of 2-methyl-4,5-dichloro-
6-hydroxy-3(2H)pyridazinone

In a manner similar to that employed in Example CXLVIII, methyl hydrazine was reacted with dichloromaleic anhydride in aqueous HCl solution to give 2-methyl-4,5-dichloro-6-hydroxy-3(2H)pyridazinone having a melting point of 229°C-230°C.

Part B. Preparation of 2-methyl-4,5,6-trichloro-
3(2H)pyridazinone

A mixture of 3.0 grams (0.02 mole) of 2-methyl-4,5-dichloro-6-hydroxy-3(2H)pyridazinone prepared in Part A above and 20 milliliters of phosphorus oxychloride was warmed until a solution was obtained and the excess of phosphorus oxychloride was evaporated under reduced pressure. The residue was immersed in ice water and this mixture was then stirred for a period of 1 hour giving a slurry of a buff solid which was isolated and dried over P_2O_5 to give 0.6 gram (0.003 mole) of 2-methyl-4,5,6-trichloro-3(2H)pyridazinone having a melting point of 96°C-98°C. This compound is referred to hereinafter as Compound 276.

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Example CLXPreparation of 2-benzyl-4,5-dichloro-
3(2H)pyridazinonePart A. Preparation of 4,5-dichloro-
3(2H)pyridazinone

To a refluxing solution of 33.6 grams (0.2 mole) of mucochloric acid in 160 milliliters of absolute ethanol was slowly added a solution of 6.7 grams (0.2 mole) of 95% hydrazine in 20 milliliters of ethanol. Refluxing was continued for a period of 2 hours after completing the feed and the mixture was then cooled causing separation of solids which were filtered off and air dried to give 24.4 grams (0.15 mole) of 4,5-dichloro-3(2H)pyridazinone having a melting point of 193°C-194°C.

Part B. Preparation of 2-benzyl-4,5-dichloro-
3(2H)pyridazinone

A mixture of 6.6 grams (0.04 mole) of 4,5-dichloro-3(2H)pyridazinone prepared in Part A above, 9.1 milliliters (0.08 mole) of benzyl chloride, 20 grams (0.14 mole) of potassium carbonate and 120 milliliters of N,N-dimethylformamide was heated at a temperature of 40°C-90°C causing the mixture to form a gel. The mixture was acidified, extracted with ether/acetone and filtered to give a brown solid. The filtrate was partitioned between ether and water, the ether phase washed with 10% sodium carbonate solution and with water, and then dried and evaporated to give 0.5 gram (0.002 mole) of

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2-benzyl-4,5-dichloro-3(2H)pyridazinone as white crystals having a melting point of 81°C-82°C. This compound is referred to hereinafter as Compound 277.

Example CLXI

Preparation of 2-(o-chlorobenzyl)-4,5-dichloro-3(2H)pyridazinone

A mixture of 3.4 grams (0.02 mole) of mucochloric acid, 5.1 grams (0.02 mole) of o-chlorobenzylhydrazine H_2SO_4 salt and 50 milliliters of absolute ethanol was heated under reflux for a period of 6 hours. The mixture was cooled and the precipitate which formed was collected and air-dried to give 3.8 grams (0.01 mole) of 2-(o-chlorobenzyl)-4,5-dichloro-3(2H)-pyridazinone as white crystals having a melting point of 114°C. This compound is referred to hereinafter as Compound 278.

Example CLXII

Preparation of 2-chloro-N-(2-methylphenyl)-maleimide

Part. A. Preparation of 2-(or 3-)chloro-N-(2-methylphenyl)maleamic acid

A mixture of 132 grams (1.0 mole) of chloromaleic anhydride and xylene was stirred and heated at a temperature of 70°C while slowly

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feeding in 107 grams (1.0 mole) of 2-methylaniline by means of a dropping funnel. On completing the 2-methylaniline feed, the reaction mixture was stirred for a period of one hour at a temperature of 70°C. The mixture was then cooled and a solid filtered off, washed with xylene, and hexane and then dried at room temperature to give 225 grams (0.94 mole) of 2-(or 3-)chloro-N-(2-methylphenyl)-maleamic acid having a melting point of 110°C.

Part B. Preparation of 2-chloro-N-(2-methylphenyl)maleimide

To a stirred mixture of 8 grams (0.10 mole) of sodium acetate and 95.0 grams (0.40 mole)

of 2-(or 3-)chloro-N-(2-methylphenyl)maleamic acid prepared in Part A above was added 122.0 grams (1.2 moles) of acetic anhydride at room temperature and the resulting mixture then stirred and heated at a temperature of 80°C for a period of 40 minutes. The reaction mixture was then cooled to a temperature of 25°C and added to 2 liters of ice water. The resulting mixture was extracted with 600 milliliters of ethyl ether and the ether extract then distilled through a one-foot unpacked column to give 75.0 grams (0.34 mole) of 2-chloro-N-(2-methylphenyl)maleimide having a boiling point of 132°C at 2 mm Hg.

This compound is referred to hereinafter as Compound 279.

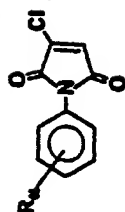
-512-

Example CLXIII

In a manner similar to that employed in Example CLXII, other compounds were prepared. The structures and analytical data for Compounds 280 through 283, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table X below.

TABLE X

Representative Heterocyclic Nitrogen-Containing Compounds



| Compound No. | Substituents R ₄ | Physical Properties |
|--------------|-------------------------------------|-----------------------------------|
| 280 | 3-CH ₃ | Boiling point 139°C-140°C/3 mm Hg |
| 281 | 4-CH ₃ | Melting point 148°C |
| 282 | 2,4-(CH ₃) ₂ | Boiling point 148°C-150°C/2 mm Hg |
| 283 | 2-C ₂ H ₅ | Boiling point 136°C/2 mm Hg |

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Example CLXIV

Preparation of N-ethylmaleimide

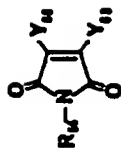
N-Ethylmaleimide was purchased from the Aldrich Chemical Company and used without further purification. A log P determination for the product indicated the following: Octanol/Water Log P by Reversed Phase HPLC 1.10. This compound is referred to hereinafter as Compound 284.

Example CLXV

Additional compounds were purchased from the Maybridge Chemical Company, Limited, Trevillet, Tintagel, Cornwall, United Kingdom and evaluated for activity. The structures and analytical data for Compounds 285 through 288, which compounds are used in the examples hereinafter for reducing moisture loss from plants, are set forth in Table Y below.

TABLE V

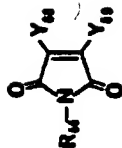
Representative Heterocyclic Nitrogen-Containing Compounds



| Compound No. | Substituents | | Octanol/Water Log P by Reversed Phase HPLC |
|--------------|--------------|---------|--|
| | R66 | Y88 Y89 | |
| 285 | | H Br | 2.31 |
| 286 | | Cl Cl | 2.74 |
| 287 | | Cl Cl | 2.57 |

TABLE V (Cont.)

Representative Heterocyclic Nitrogen-Containing Compounds



| Compound No. | Substituents | | Octanol/Water log P by Reversed Phase HPLC |
|-----------------|--------------|---------|--|
| | R66 | Y68 Y69 | |
| 288 | | H H | 1.83 |

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Example CLXVIPreparation of 2-(3-trifluoromethyl)-4,5-dichloro-3(2H)pyridazinone

2-(3-Trifluoromethyl)-4,5-dichloro-3(2H)pyridazinone was purchased from the Aldrich Chemical Company and used without further purification. A log P determination for the product indicated the following: Octanol/Water Log P by Reversed Phase HPLC 2.90.

This compound is referred to hereinafter as Compound 289.

Example CLXVIIPreparation of N-(2-ethoxyphenyl)succinimide

A mixture of 50 grams (0.5 mole) of succinic anhydride and 300 milliliters of toluene was stirred and heated at a temperature of 115°C-120°C and 69 grams (0.5 mole) of 2-ethoxyaniline was fed to this mixture from a dropping funnel. The reaction mixture was then heated to boiling and toluene distilled off to a kettle temperature of 180°C-190°C. The mixture was heated at a temperature of 180°C-190°C until the theoretical amount of water distilled from the system. The reaction mixture was cooled, diluted with one liter of 99% isopropyl alcohol and allowed to stand for a period of about 16 hours. The separated solid was filtered off, washed with isopropyl alcohol and dried to give 72.0 grams (0.33 mole) of N-(2-ethoxyphenyl)succinimide having a

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melting point of 108°C. Elemental analysis of the product indicated the following:

Analysis: $C_{12}H_{13}NO_3$

Calculated: N, 6.39

Found: N, 6.73

This compound is referred to hereinafter as Compound 290.

Example CLXVIII

Preparation of 3,5-dichloro-6-(3,5-dichloro-4-methoxyphenyl)-4-hydroxypyridazine

3,5-dichloro-6-(3,5-dichloro-4-methoxyphenyl)-4-hydroxypyridazine was obtained as a sample from the Chemie Linz Company and used without further purification. NMR analysis of the product indicated the following: 1H NMR ($CDCl_3/DMSO-d_6$) δ 164.50, 152.77, 147.92, 141.99, 131.05, 130.58, 128.88, 128.34 and 60.51. ppm.

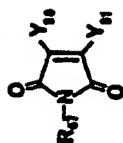
This compound is referred to hereinafter as Compound 291.

Example CLXIX

In a manner similar to that employed in Example CXLIII, other compounds were prepared. The structures and analytical data for Compounds 292 through 296, which compounds are used in the examples hereinafter for reducing moisture loss from plants are set forth in Table Z below.

TABLE 2

Representative Heterocyclic Nitrogen-Containing Compounds




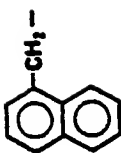
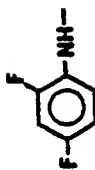
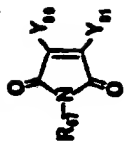
| Compound No. | Substituents | | | Elemental Analysis | | | | | | Melting Point (°C) |
|--------------|---|-----------------|-----------------|--------------------|------|------|-------|------|------|--------------------|
| | R ₆₇ | Y ₉₀ | Y ₉₁ | Calculated | | | Found | | | |
| | | | | C | H | N | C | H | N | |
| 292 |  | C1 | C1 | 43.23 | 3.63 | 5.60 | 43.02 | 3.86 | 5.34 | 011 |
| 293 |  | C1 | C1 | 58.85 | 2.96 | 4.58 | 58.93 | 3.16 | 4.58 | 128-130 |
| 294 |  | C1 | C1 | 40.99 | 1.38 | 9.56 | 41.06 | 1.35 | 9.58 | 124.5-125. |

TABLE Z

Representative Heterocyclic Nitrogen-Containing Compounds



| Compound No. | Substituents | | | Elemental Analysis | | | | Melting Point (°C) |
|--------------|--------------|-----|-----|--------------------|---------------|-------|-------|--------------------|
| | R67 | Y90 | Y91 | Calculated | Found | C | H | |
| 295 | | Cl | Cl | 33.76 0.81 | 33.11 1.13 | 11.25 | 10.79 | 132-136 |
| 296 | | Cl | H | 59.61 3.64 | 59.48 3.64 | 6.32 | 6.28 | 011 |

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Example CLXXEffect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Leaf Diffusion Resistance and Transpiration Rate

Leaf diffusion resistance is a measurement of the resistance to diffusion of water vapor from a leaf and is indicative of the transpiration rate. Transpiration rate is a measurement of the evaporation of water from cell walls and diffusion of the water out of the leaf through the stomata for a given time period. The relationship between leaf diffusion resistance and transpiration rate can be summarized as follows: the higher the leaf diffusion resistance, the lower the transpiration rate; and the lower the leaf diffusion resistance, the higher the transpiration rate. As used in Table AA below, leaf diffusion resistance and transpiration rate were determined according to the following general procedure:

Solutions of the test compounds were prepared by dissolving 30.3 milligrams of compound in 5.5 milliliters of acetone and then adding water to a final volume of 11.0 milliliters. If clouding of the solution occurred as the water was added, the use of water was discontinued and acetone was added to a final volume of 11.0 milliliters. The resulting stock solutions contained 2530 parts per million by weight of compound. The test concentrations in parts of the test compound per million parts by weight of final solution employed

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in the tests in Table AA below were obtained by appropriate dilutions of the stock suspensions with water.

Into 13.5 centimeter diameter plastic pots containing a potting soil mix, i.e., one-third sandy loam soil, one-third peat moss and one-third perlite by volume, were sown three snapbean seeds (Phaseolus vulgaris var. Cranberry). Five to seven days after planting, the plants were thinned to one plant per pot. Ten to twelve days after planting at the time of full expansion of the primary leaves, each concentration of the test compounds (each pot sprayed with 5 milliliters of solution) was applied to three snapbean plants as a foliar spray by use of an aspirated spray apparatus set at 10 psig air pressure. As a control, a water-acetone solution containing no test compound was also sprayed on three snapbean plants. When dry, all of the plants were placed in a greenhouse at a temperature of 80°F \pm 5°F and humidity of 50 percent \pm 5 percent. At 24 hours and 48 hours after treatment, leaf diffusion resistance in seconds/centimeter (sec/cm) and transpiration rate in micrograms of water/square centimeter \cdot second ($\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}$) were determined using a LI-COR 1600 steady-state porometer commercially available from Li-Cor, Inc./Li-Cor, Ltd., Lincoln, Nebraska. The values obtained for each test compound concentration and control were averaged to obtain the results in Table AA.

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TABLE AA

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on Leaf Diffusion
Resistance and Transpiration Rate

| <u>Compound</u> <u>No.</u> | <u>Leaf Diffusion</u> <u>Resistance (sec/cm)</u> | | <u>Transpiration Rate</u> <u>(μg H₂O/cm²·sec)</u> | |
|-------------------------------|---|----------------|---|----------------|
| | <u>1840 ppm</u> | <u>Control</u> | <u>1840 ppm</u> | <u>Control</u> |
| 1 | 13.8 | 3.3 | 0.3 | 1.4 |
| 2 | 14.0 | 6.0 | 1.3 | 3.3 |
| 3 | 12.1 | 3.4 | 0.8 | 2.3 |
| 4 | 15.5(c) | 5.6 | 0.6(c) | 2.2 |
| 5 | 7.8 | 4.8 | 1.2 | 1.9 |
| 6 | 16.5 | 4.3 | 0.5 | 1.7 |
| 7 | 11.0 | 5.5 | 0.6 | 1.2 |
| 8 | 14.0 | 3.3 | 0.5 | 1.7 |
| 9 | 7.5 | 6.0 | 0.8 | 1.0 |
| 10 | 4.6 | 2.2 | 0.8 | 1.5 |
| 11 | 4.6 | 2.2 | 0.8 | 1.6 |
| 12 | 4.8(c) | 2.5 | 0.8(c) | 1.2 |
| 13 | 12.7 | 7.6 | 1.0 | 1.5 |
| 14 | 4.9 | 2.9 | 0.8 | 1.2 |
| 15 | 25.8 | 5.0 | 0.4 | 1.6 |
| 16 | 18.0 | 5.7 | 0.5 | 1.5 |
| 17 | 11.1 | 5.8 | 0.8 | 1.3 |
| 18 | 9.4 | 4.9 | 1.0 | 2.2 |
| 19 | 9.9 | 6.0 | 0.8 | 1.3 |
| 20 | 18.0 | 5.4 | 0.7 | 2.1 |
| 21 | 8.7 | 1.7 | 1.1 | 5.0 |
| 22 | 8.9 | 2.8 | 1.0 | 2.9 |
| 23 | 13.6 | 4.7 | 0.8 | 2.0 |
| 24 | 24.9(b) | 4.6 | 0.4(b) | 1.8 |
| 25 | 26.5 | 5.8 | 0.6 | 2.5 |

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TABLE AA (Cont.)

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on Leaf Diffusion
Resistance and Transpiration Rate

| Compound <u>No.</u> | Leaf Diffusion | | Transpiration Rate | |
|------------------------|----------------------------|----------------|--|----------------|
| | <u>Resistance (sec/cm)</u> | | <u>($\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}$)</u> | |
| | <u>1840 ppm</u> | <u>Control</u> | <u>1840 ppm</u> | <u>Control</u> |
| 26 | 24.8 | 6.2 | 0.4 | 1.9 |
| 27 | 6.9(b) | 2.2 | 2.3(b) | 6.5 |
| 28 | 5.9 | 1.9 | 2.6 | 5.9 |
| 29 | 13.8 | 4.3 | 0.8 | 2.9 |
| 30 | 30.7 | 3.7 | 0.4 | 2.8 |
| 31 | 28.2 | 6.1 | 0.6 | 2.6 |
| 32 | 16.6 | 3.4 | 0.9 | 3.6 |
| 33 | 11.8 | 6.4 | 0.9 | 1.7 |
| 34 | 10.7 | 5.6 | 0.7 | 1.2 |
| 35 | 12.9(b) | 5.7 | 0.5(b) | 1.3 |
| 36 | 7.2 | 3.8 | 0.9 | 1.6 |
| 37 | 6.7 | 3.8 | 0.6 | 1.0 |
| 38 | 4.4 | 2.5 | 0.7 | 1.4 |
| 39 | 5.1 | 2.5 | 0.7 | 1.4 |
| 40 | 7.6 | 3.0 | 0.6 | 1.5 |
| 41 | 3.6 | 3.0 | 1.0 | 1.4 |
| 42 | 14.6 | 4.0 | 0.4 | 1.5 |
| 43 | 13.7 | 9.3 | 0.6 | 0.9 |
| 44 | 16.7 | 4.3 | 1.0 | 3.5 |
| 45 | 6.6 | 5.9 | 1.7 | 1.8 |
| 46 | 9.3 | 3.3 | 2.3 | 4.0 |
| 47 | 25.6 | 3.8 | 0.7 | 4.1 |

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TABLE AA (Cont.)

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on Leaf Diffusion
Resistance and Transpiration Rate

| Compound No. | Leaf Diffusion Resistance (sec/cm) | | Transpiration Rate ($\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}$) | |
|-----------------|---------------------------------------|---------|--|---------|
| | 1840 ppm | Control | 1840 ppm | Control |
| 48 | 10.1(b) | 9.4 | 0.8(b) | 0.9 |
| 49 | 10.2 | 9.1 | 1.1 | 1.3 |
| 50 | 9.3 | 4.8 | 1.0 | 1.9 |
| 51 | 15.8 | 5.6 | 0.5 | 1.5 |
| 52 | 13.2 | 3.3 | 1.8 | 3.4 |
| 53 | 11.6 | 4.4 | 0.5 | 1.3 |
| 54 | 7.8 | 2.4 | 1.0 | 3.3 |
| 55 | 8.4 | 4.3 | 1.1 | 3.3 |
| 56 | 16.1 | 6.2 | 1.0 | 2.5 |
| 57 | 6.4 | 2.1 | 1.3 | 3.7 |
| 58 | 3.8 | 2.8 | 1.7 | 2.3 |
| 59 | 8.2 | 2.8 | 0.8 | 2.2 |
| 60 | 3.9 | 1.8 | 2.1 | 3.8 |
| 61 | 9.5 | 5.6 | 0.9 | 1.5 |
| 62 | 15.4 | 5.5 | 0.6 | 1.5 |
| 63 | 8.5 | 6.9 | 1.1 | 1.4 |
| 64 | 8.7 | 4.2 | 1.6 | 3.3 |
| 65 | 21.7 | 13.9 | 0.4 | 0.8 |
| 66 | 11.2(c) | 8.5 | 0.7(c) | 0.8 |
| 67 | 10.7 | 8.1 | 0.7 | 0.9 |
| 68 | 5.2 | 4.4 | 1.2 | 1.4 |
| 69 | 12.1 | 4.4 | 0.5 | 1.3 |

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TABLE AA (Cont.)

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on Leaf Diffusion
Resistance and Transpiration Rate

| Compound No. | Leaf Diffusion | | Transpiration Rate | |
|-----------------|----------------------------|----------------|--|----------------|
| | <u>Resistance (sec/cm)</u> | | <u>($\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}$)</u> | |
| | <u>1840 ppm</u> | <u>Control</u> | <u>1840 ppm</u> | <u>Control</u> |
| 70 | 3.4 | 2.2 | 0.8 | 1.3 |
| 71 | 2.5 | 2.0 | 1.4 | 1.6 |
| 72 | 14.4 | 2.1 | 1.4 | 4.3 |
| 73 | 5.4 | 3.6 | 1.4 | 2.0 |
| 74 | 5.0(b) | 3.2 | 0.9(b) | 1.4 |
| 75 | 10.3 | 6.3 | 1.3 | 1.8 |
| 76 | 12.7 | 7.4 | 1.0 | 1.7 |
| 77 | 13.5 | 4.4 | 0.6 | 1.9 |
| 78 | 10.3 | 3.7 | 1.1 | 2.8 |
| 79 | 19.8 | 5.3 | 0.4 | 1.4 |
| 80 | 14.4(c) | 7.6 | 0.8(c) | 1.5 |
| 81 | 10.1(c) | 4.7 | 1.0(c) | 2.0 |
| 82 | 19.0 | 6.1 | 0.5 | 1.3 |
| 83 | 26.7 | 6.5 | 0.3 | 1.2 |
| 84 | 7.4(c) | 6.5 | 1.1(c) | 1.3 |
| 85 | 13.4 | 9.2 | 1.0 | 1.6 |
| 86 | 6.8 | 4.0 | 1.1 | 1.5 |
| 87 | 14.8 | 4.3 | 0.9 | 2.8 |
| 88 | 6.5 | 6.8 | 1.0 | 1.2 |
| 89 | 11.4(b) | 9.7 | 1.0(b) | 1.2 |
| 90 | 10.4(e) | 5.8 | 1.2(e) | 2.0 |
| 91 | 4.8 | 3.3 | 1.6 | 2.2 |

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TABLE AA (Cont.)

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on Leaf Diffusion
Resistance and Transpiration Rate

| Compound No. | Leaf Diffusion | | Transpiration Rate | |
|-----------------|----------------------------|----------------|---|----------------|
| | <u>Resistance (sec/cm)</u> | | <u>($\mu\text{g H}_2\text{O/cm}^2 \cdot \text{sec}$)</u> | |
| | <u>1840 ppm</u> | <u>Control</u> | <u>1840 ppm</u> | <u>Control</u> |
| 92 | 9.5 | 3.9 | 0.7 | 1.6 |
| 93 | 8.1 | 3.5 | 0.9 | 2.0 |
| 94 | 12.0 | 6.8 | 0.8 | 1.3 |
| 95 | 10.0(b) | 6.4 | 0.9(b) | 1.4 |
| 96 | 10.0 | 6.5 | 1.0 | 1.4 |
| 97 | 3.1 | 1.7 | 1.6 | 2.1 |
| 98 | 2.7 | 1.3 | 1.4 | 2.6 |
| 99 | 17.1 | 9.9 | 0.5 | 0.9 |
| 100 | 6.2 | 4.3 | 1.3 | 1.8 |
| 101 | 15.2(b) | 7.9 | 0.7(b) | 1.3 |
| 102 | 13.3(b) | 4.7 | 0.9(b) | 2.0 |
| 103 | 10.5(b) | 5.5 | 1.8(b) | 2.5 |
| 104 | 8.6 | 2.1 | 1.2 | 4.2 |
| 105 | 9.9 | 5.4 | 0.9 | 1.6 |
| 106 | 12.3 | 10.1 | 1.0 | 1.3 |
| 107 | 7.4 | 2.4 | 0.5 | 1.4 |
| 108 | 22.8 | 9.5 | 0.4 | 1.0 |
| 109 | 7.1 | 5.1 | 1.4 | 2.0 |
| 110 | 14.2(b) | 6.3 | 0.7(b) | 1.4 |
| 111 | 11.2 | 5.7 | 0.8 | 1.4 |
| 112 | 10.9 | 6.7 | 1.0 | 1.6 |
| 113 | 13.3(b) | 5.6 | 0.6(b) | 1.3 |

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TABLE AA (Cont.)

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on Leaf Diffusion
Resistance and Transpiration Rate

| Compound No. | Leaf Diffusion | | Transpiration Rate | |
|-----------------|----------------------------|----------------|--|----------------|
| | <u>Resistance (sec/cm)</u> | | <u>($\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}$)</u> | |
| | <u>1840 ppm</u> | <u>Control</u> | <u>1840 ppm</u> | <u>Control</u> |
| 114 | 15.0(b) | 6.0 | 0.6(b) | 1.4 |
| 115 | 8.0 | 6.6 | 0.9 | 1.1 |
| 116 | 8.6 | 7.0 | 1.2 | 1.7 |
| 117 | 13.5 | 3.6 | 0.7 | 2.2 |
| 118 | 3.3 | 2.0 | 1.2 | 1.8 |
| 119 | 8.7 | 7.1 | 0.6 | 0.8 |
| 120 | 10.1 | 9.8 | 1.1 | 1.3 |
| 121 | 11.4 | 5.7 | 0.7 | 1.3 |
| 122 | 8.7(b) | 6.6 | 0.8(b) | 1.4 |
| 123 | 1.9 | 1.0 | 2.4 | 3.9 |
| 124 | 1.8(b) | 1.3 | 2.3(b) | 2.6 |
| 125 | 8.9 | 6.6 | 0.8 | 1.1 |
| 126 | 6.2 | 5.8 | 1.2 | 1.3 |
| 127 | 7.9 | 5.4 | 1.0 | 1.4 |
| 128 | 12.4 | 5.8 | 0.7 | 1.6 |
| 129 | 5.1 | 4.2 | 1.1 | 1.4 |
| 130 | 6.8 | 5.0 | 0.8 | 1.0 |
| 131 | 11.2 | 5.0 | 0.6 | 1.3 |
| 132 | 12.6(c) | 7.3 | 0.9(c) | 1.5 |
| 133 | 6.6 | 4.3 | 1.3 | 2.0 |
| 134 | 11.0 | 8.4 | 1.3 | 1.5 |
| 135 | 9.7 | 8.3 | 1.2 | 1.5 |

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TABLE AA (Cont.)

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on Leaf Diffusion
Resistance and Transpiration Rate

| Compound No. | Leaf Diffusion | | Transpiration Rate | |
|-----------------|----------------------------|----------------|--|----------------|
| | <u>Resistance (sec/cm)</u> | | <u>($\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}$)</u> | |
| | <u>1840 ppm</u> | <u>Control</u> | <u>1840 ppm</u> | <u>Control</u> |
| 136 | 3.9 | 3.7 | 2.4 | 2.6 |
| 137 | 6.4(c) | 5.7 | 1.3(c) | 1.4 |
| 138 | 6.7(c) | 2.6 | 0.6(c) | 1.4 |
| 139 | 7.7(c) | 5.3 | 1.0(c) | 1.5 |
| 140 | 8.8 | 7.1 | 1.5 | 1.8 |
| 141 | 10.8(c) | 6.2 | 0.7(c) | 1.2 |
| 142 | 8.4(c) | 6.7 | 1.3(c) | 1.8 |
| 143 | 6.5 | 5.2 | 1.3 | 1.7 |
| 144 | 8.1 | 4.9 | 0.9 | 1.4 |
| 145 | 12.6(c) | 8.6 | 0.8(c) | 1.1 |
| 146 | 8.4 | 8.2 | 1.1 | 1.2 |
| 147 | 7.8 | 4.8 | 1.1 | 1.7 |
| 148 | 11.1(c) | 7.4 | 0.5(c) | 0.8 |
| 149 | 6.3(c) | 5.4 | 1.4(c) | 1.6 |
| 150 | 5.5(c) | 4.6 | 1.4(c) | 1.6 |
| 151 | 8.3 | 6.1 | 1.7 | 2.3 |
| 152 | 12.7(c) | 6.5 | 0.7(c) | 1.3 |
| 153 | 14.9 | 2.3 | 0.6 | 3.5 |
| 154 | 9.4(b) | 8.1 | 0.8(b) | 1.0 |
| 155 | 28.4(b) | 6.7 | 0.3(b) | 1.1 |
| 156 | 12.0 | 5.8 | 0.6 | 1.2 |
| 157 | 9.5 | 2.2 | 0.6 | 1.9 |

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TABLE AA (Cont.)

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on Leaf Diffusion
Resistance and Transpiration Rate

| Compound No. | Leaf Diffusion | | Transpiration Rate | |
|-----------------|----------------------------|----------------|---|----------------|
| | <u>Resistance (sec/cm)</u> | | <u>($\mu\text{g H}_2\text{O/cm}^2 \cdot \text{sec}$)</u> | |
| | <u>1840 ppm</u> | <u>Control</u> | <u>1840 ppm</u> | <u>Control</u> |
| 158 | 10.8 | 5.0 | 0.6 | 1.3 |
| 159 | 6.3 | 1.9 | 0.7 | 1.6 |
| 160 | 6.5 | 4.4 | 0.9 | 1.4 |
| 161 | 17.2 | 8.2 | 0.3 | 0.8 |
| 162 | 4.3(a) | 3.4 | 0.9(a) | 1.2 |
| 163 | 3.2(a) | 2.6 | 1.0(a) | 1.3 |
| 164 | 4.6 | 4.4 | 2.3 | 2.4 |
| 165 | 4.0 | 3.6 | 2.5 | 2.9 |
| 166 | 5.6(d) | 4.9 | 1.1(d) | 1.3 |
| 167 | 9.9 | 9.7 | 1.2 | 1.3 |
| 168 | 4.2 | 3.5 | 2.2 | 2.7 |
| 169 | 5.4 | 5.2 | 1.9 | 2.1 |
| 170 | 6.8 | 3.1 | 1.2 | 3.0 |
| 171 | 6.4 | 5.2 | 1.2 | 1.5 |
| 172 | 11.2 | 8.1 | 1.1 | 1.4 |
| 173 | 22.2 | 4.9 | 0.5 | 2.0 |
| 174 | 10.6 | 6.3 | 0.8 | 1.9 |
| 175 | 6.4 | 4.2 | 1.8 | 2.6 |
| 176 | 6.3 | 4.9 | 2.1 | 2.6 |
| 177 | 7.3 | 6.6 | 1.4 | 1.6 |
| 178 | 38.0 | 5.5 | 0.5 | 3.1 |
| 179 | 12.4 | 4.8 | 1.1 | 2.3 |

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TABLE AA (Cont.)

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on Leaf Diffusion
Resistance and Transpiration Rate

| Compound No. | Leaf Diffusion | | Transpiration Rate | |
|-----------------|----------------------------|----------------|--|----------------|
| | <u>Resistance (sec/cm)</u> | | <u>($\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}$)</u> | |
| | <u>1840 ppm</u> | <u>Control</u> | <u>1840 ppm</u> | <u>Control</u> |
| 180 | 7.3 | 6.9 | 1.7 | 1.8 |
| 181 | 10.8 | 5.4 | 2.0 | 2.7 |
| 182 | 5.7 | 3.5 | 2.0 | 3.5 |
| 183 | 16.6 | 8.5 | 1.0 | 2.0 |
| 184 | 7.1 | 4.0 | 1.0 | 1.8 |
| 185 | 5.4 | 4.9 | 1.9 | 2.0 |
| 186 | 7.3 | 5.8 | 1.7 | 2.3 |
| 187 | 6.7 | 2.6 | 1.1 | 3.7 |
| 188 | 8.7 | 4.7 | 1.6 | 2.6 |
| 189 | 11.5 | 5.7 | 1.6 | 2.6 |
| 190 | 2.7 | 2.5 | 3.1 | 3.3 |
| 191 | 12.3 | 6.4 | 1.1 | 1.7 |
| 192 | 15.0 | 9.3 | 1.1 | 1.8 |
| 193 | 5.2 | 4.0 | 1.4 | 1.9 |
| 194 | 3.7 | 2.5 | 2.5 | 3.5 |
| 195 | 9.5 | 3.9 | 1.3 | 2.6 |
| 196 | 14.1 | 2.2 | 0.7 | 4.6 |
| 197 | 23.1 | 3.3 | 0.7 | 5.1 |
| 198 | 19.2 | 1.8 | 0.7 | 5.2 |
| 199 | 17.1 | 3.7 | 0.9 | 4.0 |
| 200 | 8.2 | 2.5 | 1.3 | 3.9 |
| 201 | 20.4 | 3.8 | 0.8 | 3.7 |

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TABLE AA (Cont.)

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on Leaf Diffusion
Resistance and Transpiration Rate

| <u>Compound No.</u> | <u>Leaf Diffusion Resistance (sec/cm)</u> | | <u>Transpiration Rate ($\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}$)</u> | |
|-------------------------|---|----------------|---|----------------|
| | <u>1840 ppm</u> | <u>Control</u> | <u>1840 ppm</u> | <u>Control</u> |
| 202 | 9.5 | 3.5 | 2.0 | 4.3 |
| 203 | 19.7 | 8.8 | 0.7 | 1.7 |
| 204 | 30.3 | 4.1 | 0.6 | 3.5 |
| 205 | 7.7 | 6.2 | 1.4 | 1.7 |
| 206 | 9.3 | 6.0 | 1.4 | 2.0 |
| 207 | 20.9 | 6.6 | 0.6 | 1.7 |
| 208 | 13.5 | 4.8 | 1.1 | 3.0 |
| 209 | 8.1 | 5.4 | 1.1 | 2.0 |
| 210 | 7.1 | 5.4 | 1.7 | 2.3 |
| 211 | 6.0 (c) | 5.6 | 2.3 (c) | 2.5 |
| 212 | 7.8 (b) | 4.5 | 1.6 (b) | 2.7 |
| 213 | 6.0 (b) | 5.9 | 2.0 (b) | 2.1 |
| 214 | 9.3 | 7.1 | 1.2 | 1.6 |
| 215 | 6.6 | 5.5 | 1.0 | 1.3 |
| 216 | 7.9 | 5.8 | 1.4 | 1.9 |
| 217 | 5.9 | 4.6 | 1.7 | 2.1 |
| 218 | 7.5 | 4.6 | 1.5 | 2.0 |
| 219 | 8.3 | 3.1 | 1.8 | 4.6 |
| 220 | 14.0 | 4.6 | 0.8 | 2.3 |
| 221 | 10.6 | 5.5 | 1.2 | 2.4 |
| 222 | 23.0 | 6.9 | 0.5 | 1.6 |
| 223 | 9.9 | 5.6 | 1.3 | 2.1 |
| 224 | 9.4 | 3.8 | 1.7 | 3.7 |

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TABLE AA (Cont.)

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on Leaf Diffusion
Resistance and Transpiration Rate

| <u>Compound No.</u> | <u>Leaf Diffusion Resistance (sec/cm)</u> | | <u>Transpiration Rate ($\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}$)</u> | |
|-------------------------|---|----------------|---|----------------|
| | <u>1840 ppm</u> | <u>Control</u> | <u>1840 ppm</u> | <u>Control</u> |
| 225 | 6.7 | 5.7 | 2.4 | 3.1 |
| 226 | 9.6 | 6.9 | 1.7 | 2.2 |
| 227 | 8.4 (b) | 6.7 | 1.8 (b) | 2.3 |
| 228 | 31.1 | 5.7 | 0.5 | 2.3 |
| 229 | 25.0 | 3.6 | 0.4 | 2.5 |
| 230 | 25.1 | 6.7 | 0.5 | 1.6 |
| 231 | 5.9 | 2.1 | 1.9 | 4.3 |
| 232 | 6.9 | 3.8 | 2.8 | 4.0 |
| 233 | 11.8 | 4.2 | 1.6 | 4.4 |
| 234 | 15.4 (b) | 3.7 | 0.9 (b) | 3.3 |
| 235 | 12.6 | 3.1 | 1.0 | 4.0 |
| 236 | 6.7 | 5.3 | 1.7 | 2.1 |
| 237 | 21.8 | 2.6 | 0.7 | 5.1 |
| 238 | 3.7 | 2.6 | 2.9 | 3.9 |
| 239 | 25.1 | 2.6 | 0.8 | 4.4 |
| 240 | 11.4 | 5.5 | 1.3 | 2.7 |
| 241 | 11.2 (c) | 3.6 | 1.3 (c) | 3.5 |
| 242 | 11.5 | 2.1 | 1.3 | 6.2 |
| 243 | 18.3 | 5.6 | 0.6 | 1.8 |
| 244 | 11.5 | 2.9 | 0.4 | 1.4 |
| 245 | 10.8 | 3.4 | 1.4 | 3.9 |
| 246 | 11.4 | 3.0 | 1.1 | 3.9 |
| 247 | 10.4 | 2.6 | 1.5 | 5.2 |

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TABLE AA (Cont.)

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on Leaf Diffusion
Resistance and Transpiration Rate

| <u>Compound</u> <u>No.</u> | <u>Leaf Diffusion</u> <u>Resistance (sec/cm)</u> | | <u>Transpiration Rate</u> <u>($\mu\text{g H}_2\text{O}/\text{cm}^2 \cdot \text{sec}$)</u> | |
|-------------------------------|---|----------------|---|----------------|
| | <u>1840 ppm</u> | <u>Control</u> | <u>1840 ppm</u> | <u>Control</u> |
| 248 | 3.8 | 2.5 | 1.1 | 1.6 |
| 249 | 3.1 | 2.8 | 3.9 | 4.3 |
| 250 | 2.6 | 1.9 | 6.0 | 8.2 |
| 251 | 3.3 | 2.8 | 3.8 | 4.1 |
| 252 | 5.1 | 4.1 | 2.3 | 2.9 |
| 253 | 3.3 (b) | 2.7 | 3.5 (b) | 4.1 |
| 254 | 5.4 | 4.2 | 1.5 | 2.0 |
| 255 | 5.0 | 3.8 | 2.0 | 2.9 |
| 256 | 4.3 | 2.2 | 3.2 | 5.5 |
| 257 | 28.8 | 3.9 | 0.5 | 3.4 |
| 258 | 2.9 | 2.7 | 4.0 | 4.7 |
| 259 | 14.2 | 4.7 | 0.7 | 1.9 |
| 260 | 30.1 | 2.9 | 0.4 | 3.2 |
| 261 | 10.4 | 3.2 | 0.4 | 1.2 |
| 262 | 17.8 | 2.8 | 0.5 | 3.6 |
| 263 | 10.2 | 3.3 | 0.4 | 1.2 |
| 264 | 22.8 | 4.6 | 0.6 | 2.7 |
| 265 | 3.7 | 2.6 | 2.5 | 3.5 |
| 266 | 14.3 | 5.7 | 1.2 | 2.9 |
| 267 | 12.0 | 4.1 | 1.0 | 2.4 |
| 268 | 6.1 | 2.6 | 3.2 | 6.7 |
| 269 | 11.3 | 6.9 | 1.7 | 2.6 |
| 270 | 19.5 | 6.4 | 0.9 | 2.6 |

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TABLE AA (Cont.)

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on Leaf Diffusion
Resistance and Transpiration Rate

| <u>Compound</u> <u>No.</u> | <u>Leaf Diffusion</u> <u>Resistance (sec/cm)</u> | | <u>Transpiration Rate</u> <u>(μg H₂O/cm². sec)</u> | |
|-------------------------------|---|----------------|--|----------------|
| | <u>1840 ppm</u> | <u>Control</u> | <u>1840 ppm</u> | <u>Control</u> |
| 271 | 19.5 (c) | 7.9 | 0.9 (c) | 2.4 |
| 272 | 18.6 | 4.7 | 0.9 | 3.5 |
| 273 | 18.8 | 5.1 | 0.8 | 3.1 |
| 274 | 21.8 | 4.9 | 0.8 | 3.3 |
| 275 | 6.9 | 3.3 | 1.6 | 3.2 |
| 276 | 5.3 | 4.3 | 2.2 | 2.9 |
| 277 | 5.9 (c) | 3.5 | 3.0 (c) | 3.4 |
| 278 | 11.0 | 4.5 | 1.8 | 2.7 |
| 279 | 14.6 | 4.0 | 0.9 | 2.8 |
| 280 | 17.6 | 3.1 | 0.6 | 3.4 |
| 281 | 14.8 | 5.3 | 0.9 | 2.3 |
| 282 | 12.4 | 3.3 | 1.1 | 3.1 |
| 283 | 9.3 | 3.7 | 1.8 | 4.4 |
| 284 | 8.8 (d) | 3.9 | 1.5 (d) | 3.0 |
| 285 | 13.9 | 2.4 | 1.0 | 5.5 |
| 286 | 9.7 | 2.0 | 1.2 | 5.1 |
| 287 | 5.6 | 2.4 | 0.7 | 1.5 |
| 288 | 6.2 | 3.4 | 2.2 | 3.8 |
| 289 | 3.5 | 2.8 | 3.3 | 4.3 |
| 290 | 9.0 | 6.2 | 2.0 | 2.7 |
| 291 | 2.1 | 1.9 | 1.4 | 1.5 |
| 292 | 23.8 (b) | 6.2 | 0.6 (b) | 2.3 |
| 293 | 4.8 (c) | 4.4 | 2.3 (c) | 2.4 |

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TABLE AA (Cont.)

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on Leaf Diffusion
Resistance and Transpiration Rate

| <u>Compound</u> <u>No.</u> | <u>Leaf Diffusion</u> <u>Resistance (sec/cm)</u> | | <u>Transpiration Rate</u> <u>(μg H₂O/cm². sec)</u> | |
|-------------------------------|---|----------------|--|----------------|
| | <u>1840 ppm</u> | <u>Control</u> | <u>1840 ppm</u> | <u>Control</u> |
| 294 | 31.5 | 9.3 | 0.5 | 1.8 |
| 295 | 28.3 (c) | 7.5 | 0.5 (c) | 1.4 |
| 296 | 27.6 | 6.7 | 0.5 | 2.0 |

-
- (a) Treated at 115 parts per million.
(b) Treated at 230 parts per million.
(c) Treated at 460 parts per million.
(d) Treated at 920 parts per million.
(e) Treated at 3220 parts per million.

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The results in Table AA demonstrate that representative heterocyclic nitrogen-containing compounds used in the method of this invention significantly increase leaf diffusion resistance and decrease transpiration rate relative to untreated controls.

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Example CLXXIWater-Use Efficiency of
Representative Heterocyclic
Nitrogen-Containing Compounds

Water-use efficiency (WUE) is a determination of both the effectiveness of an antitranspirant compound, i.e., control of water usage by plants, and also the effect of such compound on plant growth, i.e., effect on plant photosynthesis. In particular, WUE is defined as the unit of plant dry matter produced per unit of water utilized for a given time period. As used in Tables BB through FF below, WUE was determined according to the following general procedure:

Solutions of the compounds identified in Tables BB through FF were prepared by dissolving 62.5 milligrams of the test compound into 5 milliliters of acetone. Two, one and 0.5 milliliters of this solution were placed into separate tubes, acetone was added to each tube to a total volume of 12 milliliters and water was then added to each tube to a final volume of 20 milliliters. Final concentrations of test compound in the above stock solutions were 1250 parts per million, 625 parts per million and 312 parts per million by weight. The other concentrations in parts of the test compound per million parts by weight of final solution employed in the tests described hereinbelow were obtained by appropriate dilutions of the stock solutions with water.

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Into 10.2 centimeter diameter plastic pots containing a potting soil, i.e., one-third sandy loam soil, one-third peat moss and one-third perlite by volume, were sown 12 milligrams of Kentucky bluegrass seeds or tall fescue turfgrass seeds. The plastic pots and potting soil were each weighed before sowing the seeds. The bluegrass and turfgrass were allowed to grow for a period of 8 to 12 weeks after planting and the height of the grasses was maintained at 2.5-3.8 centimeters during this period. Twelve hours prior to application of the test compounds identified in Tables O through S, the bluegrass and turfgrass were clipped to a uniform height of 2.5-3.8 centimeters, and the weight of each pot was obtained prior to treatment. Each concentration of the test compounds including the controls was applied by spraying to four pots (each pot sprayed with 5 milliliters of solution) by use of an aspirated spray apparatus set at 10 psig air pressure. As a control, a water-acetone solution containing no test compound was also applied to four pots. When dry, all of the pots were placed in a greenhouse at a temperature of 80°F \pm 5°F and humidity of 50 percent \pm 5 percent for a 7 day period with no watering. All pots were weighed every 24 hours and the amount of water utilized was determined by calculation using the daily weights and the initial weights. At the end of the 7 day period, visual observations were made of the grasses in all pots. The grasses were then clipped to a uniform height and the clippings were collected, dried and weighed for each pot.

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Water use was calculated using the following equation:

$$\text{Water use} = \frac{\text{grams of H}_2\text{O utilized by treated grasses}}{(\% \text{ of Control}) \text{ grams of H}_2\text{O utilized by untreated grasses (control)}}$$

WUE was calculated using the following equation:

$$\text{WUE} = \frac{\text{milligrams of dry weight of clippings}}{\text{grams of water utilized}}$$

The WUE was standardized to the control for each of the tests using the following equation:

$$\text{WUE Index} = \frac{\text{WUE for treated grasses}}{\text{WUE for untreated grasses (control)}}$$

The values obtained for each test compound concentration and control were averaged to obtain the results in Tables BB through FF.

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TABLE BB
Water-Use Efficiency of Representative
Heterocyclic Nitrogen-Containing
Compounds on Kentucky Bluegrass

| <u>Compound</u> <u>No.</u> | <u>Concentration</u> <u>(ppm)</u> | <u>Water Use</u> <u>(% of Control)</u> | <u>WUE</u> | <u>WUE Index</u> |
|-------------------------------|--------------------------------------|---|------------|------------------|
| Control | - | 100 | 0.59 | 1.00 |
| 28 | 312 | 55 | 1.45 | 2.46 |
| | 625 | 57 | 2.04 | 3.46 |
| | 1250 | 54 | 2.59 | 4.39 |
| 30 | 312 | 62 | 1.25 | 2.12 |
| | 625 | 64 | 1.53 | 2.59 |
| | 1250 | 65 | 1.33 | 2.25 |
| 44 | 312 | 66 | 1.76 | 2.98 |
| | 625 | 48 | 2.40 | 4.07 |
| | 1250 | 35 | 4.05 | 6.86 |

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TABLE CC
Water-Use Efficiency of Representative
Heterocyclic Nitrogen-Containing
Compounds on Kentucky Bluegrass

| <u>Compound</u> <u>No.</u> | <u>Concentration</u> <u>(ppm)</u> | <u>Water Use</u> <u>(% of Control)</u> | <u>WUE</u> | <u>WUE Index</u> |
|-------------------------------|--------------------------------------|---|------------|------------------|
| Control | - | 100 | 0.78 | 1.00 |
| Atrazine* | 39 | 48 | 1.42 | 1.82 |
| | 78 | 36 | 1.34 | 1.72 |
| | 156 | 37 | 0.44 | 0.56 |
| | 312 | 36 | 0.31 | 0.40 |
| 26 | 312 | 63 | 2.49 | 3.19 |
| | 625 | 59 | 1.72 | 2.21 |
| | 1250 | 65 | 1.20 | 1.54 |
| 44 | 312 | 41 | 3.07 | 3.94 |
| | 625 | 39 | 3.56 | 4.56 |
| | 1250 | 36 | 3.51 | 4.50 |

*Grass damaged at all concentrations; nearly all grass dead at concentrations greater than 78 parts per million; substantial phytotoxicity.

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TABLE DD
Water-Use Efficiency of Representative
Heterocyclic Nitrogen-Containing
Compounds on Kentucky Bluegrass

| <u>Compound</u> <u>No.</u> | <u>Concentration</u> <u>(ppm)</u> | <u>Water Use</u> <u>(% of Control)</u> | <u>WUE</u> | <u>WUE Index</u> |
|-------------------------------|--------------------------------------|---|------------|------------------|
| Control | - | 100 | 2.47 | 1.00 |
| Atrazine* | 10 | 65 | 2.87 | 1.03 |
| | 20 | 64 | 2.42 | 1.16 |
| | 39 | 65 | 2.65 | 0.98 |
| 32 | 312 | 89 | 2.65 | 1.07 |
| | 625 | 81 | 2.85 | 1.15 |
| | 1250 | 87 | 3.00 | 1.21 |
| 44 | 625 | 58 | 3.70 | 1.50 |
| | 938 | 52 | 4.38 | 1.77 |
| | 1250 | 49 | 3.94 | 1.59 |
| 64 | 312 | 86 | 2.54 | 1.03 |
| | 625 | 87 | 2.47 | 1.00 |
| | 1250 | 86 | 2.73 | 1.11 |

*Grass damaged at all concentrations; substantial phytotoxicity.

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TABLE EE
Water-Use Efficiency of Representative
Heterocyclic Nitrogen-Containing
Compounds on Kentucky Bluegrass

| <u>Compound</u> <u>No.</u> | <u>Concentration</u> <u>(ppm)</u> | <u>Water Use</u> <u>(% of Control)</u> | <u>WUE</u> | <u>WUE Index</u> |
|-------------------------------|--------------------------------------|---|------------|------------------|
| Control | - | 100 | 3.90 | 1.00 |
| 44 | 625 | 49.0 | 8.00 | 2.05 |
| | 938 | 41.3 | 12.0 | 3.08 |
| 54 | 312 | 63.9 | 7.00 | 1.79 |
| | 625 | 63.1 | 6.50 | 1.67 |

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TABLE FF
Water-Use Efficiency of Representative
Heterocyclic Nitrogen-Containing
Compounds on Tall Fescue Turfgrass

| <u>Compound</u> <u>No.</u> | <u>Concentration</u> <u>(ppm)</u> | <u>Water Use</u> <u>(% of Control)</u> | <u>WUE</u> | <u>WUE Index</u> |
|-------------------------------|--------------------------------------|---|------------|------------------|
| Control | - | 100 | 0.74 | 1.00 |
| Atrazine* | 5 | 81 | 1.26 | 1.70 |
| | 10 | 83 | 1.09 | 1.47 |
| | 20 | 106 | 0.80 | 1.35 |
| 18 | 312 | 62 | 1.28 | 1.60 |
| | 625 | 61 | 2.02 | 2.73 |
| | 1250 | 57 | 1.75 | 2.36 |
| 44 | 625 | 78 | 1.56 | 2.11 |
| | 1250 | 54 | 2.04 | 2.76 |
| 101 | 312 | 96 | 1.77 | 2.39 |
| | 625 | 58 | 0.99 | 1.34 |
| | 1250 | 52 | 1.86 | 2.51 |

*Grass damaged at all concentrations; substantial phytotoxicity.

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The results in Tables BB through FF demonstrate that representative heterocyclic nitrogen-containing compounds used in the method of this invention significantly decrease water use relative to untreated controls with no negative effect on plant growth, i.e., no negative effect on plant photosynthesis. In contrast, the treatment of grasses with atrazine caused substantial phytotoxicity.

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Example CLXXII
Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Crop Yield Enhancement - Corn

Agronomic uses of compounds having antitranspirant activity include not only water conservation but also crop yield enhancement. As an illustration, an antitranspirant compound applied to a crop may increase actual crop yields by reducing water loss during periods of critical water need. As used in Table GG below, crop yield enhancement was determined for corn according to the following general procedure:

Solutions of Compound 44 were prepared by dissolving either 0.78 grams, 1.55 grams or 3.10 grams of the compound into 780 milliliters of acetone. Just prior to the time of application, water was added to each of the above solutions to a final volume of 1300 milliliters. Solutions of a control having no test compound were also prepared by mixing 780 milliliters of acetone and 520 milliliters of water to a total volume of 1300 milliliters.

The above formulations were applied to corn by utilizing a statistical treatment procedure involving 42 separate plots. Each plot consisted of 4 rows individually 20 feet in length and about 3 feet between rows. Each experiment was designed as a randomized complete block of six different repetitions in which each repetition included the following: (1) treatment with control having no test compound; (2) treatment with 0.78 grams/plot of

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Compound 44 at time T_1 designated in Table GG; (3) treatment with 1.55 grams/plot of Compound 44 at time T_1 designated in Table GG; (4) treatment with 3.10 grams/plot of Compound 44 at time T_1 designated in Table GG; (5) treatment with 0.78 grams/plot of Compound 44 at time T_2 designated in Table GG; (6) treatment with 1.55 grams/plot of Compound 44 at time T_2 designated in Table GG; and (7) treatment with 3.10 grams/plot of Compound 44 at time T_2 designated in Table GG. The above formulations were applied to each plot by use of a carbon dioxide backpack sprayer set at about 20-40 psig air pressure. The planting, application and harvesting times for the corn crop are detailed in Table GG. The harvested corn crop for yield determination included the inner 10 feet of the middle 2 rows in each plot (5 feet in from ends of the middle 2 rows). Water stress conditions existed to a degree during at least a portion of the growing period. The values obtained for each plot in each repetition were averaged to obtain the results in Table GG.

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TABLE GG
Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Crop Yield Enhancement-Corn

| <u>Compound</u> <u>No.</u> | <u>Concentration</u> <u>(gm/plot)</u> | <u>Application Timing*</u> | <u>Actual Yield</u> <u>(kg/plot)</u> |
|-------------------------------|--|--------------------------------|---|
| Control | - | - | 9.87 |
| 44 | 0.78 | Tassel (T_1) | 10.71 |
| | 1.55 | Tassel (T_1) | 10.62 |
| | 3.10 | Tassel (T_1) | 10.39 |
| 44 | 0.78 | 3 Weeks after Tassel (T_2) | 11.17 |
| | 1.55 | 3 Weeks after Tassel (T_2) | 11.18 |
| | 3.10 | 3 Weeks after Tassel (T_2) | 10.30 |

*First application at tassel (T_1), 46 days after planting; second application at 3 weeks after tassel (T_2), 67 days after planting; and harvesting occurred 114 days after planting.

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The results in Table GG demonstrate that treatment of corn with a representative heterocyclic nitrogen-containing compound, i.e., Compound 44, in accordance with the method of this invention significantly increases corn crop yield in comparison with untreated control corn crops at similar conditions.

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Example CLXXIII
Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Crop Yield Enhancement - Cotton

Agronomic uses of compounds having antitranspirant activity include not only water conservation but also crop yield enhancement. As an illustration, an antitranspirant compound applied to a crop may increase actual crop yields by reducing water loss during periods of critical water need. As used in Table HH below, crop yield enhancement was determined for cotton according to the following general procedure:

Solutions of Compound 44 were prepared by dissolving either 0.78 grams, 1.55 grams or 3.10 grams of the compound into 780 milliliters of acetone. Just prior to the time of application, water was added to each of the above solutions to a final volume of 1300 milliliters. Solutions of a control having no test compound were also prepared by mixing 780 milliliters of acetone and 520 milliliters of water to a total volume of 1300 milliliters.

The above formulations were applied to cotton by utilizing a statistical treatment procedure involving 36 separate plots. Each plot consisted of 4 rows individually 20 feet in length and about 3 feet between rows. Each experiment was designed as a randomized complete block of six different repetitions in which each repetition included the following: (1) treatment with control having no test compound; (2) treatment with 0.78

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grams/plot of Compound 44 at time T_1 designated in Table HH; (3) treatment with 1.55 grams/plot of Compound 44 at time T_1 designated in Table HH; (4) treatment with 3.10 grams/plot of Compound 44 at time T_1 designated in Table HH; (5) treatment with 0.78 grams/plot of Compound 44 at time T_2 designated in Table HH; and (6) treatment with 3.10 grams/plot of Compound 44 at time T_2 designated in Table HH. The above formulations were applied to each plot by use of a carbon dioxide backpack sprayer set at about 20-40 psig air pressure. The planting, application and harvesting times for the cotton crop are detailed in Table HH. The harvested cotton crop for yield determination included the inner 10 feet of the middle 2 rows in each plot (5 feet in from ends of the middle 2 rows). Water stress conditions existed to a degree during at least a portion of the growing period. The values obtained for each plot in each repetition were averaged to obtain the results in Table HH.

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TABLE HH
Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Crop Yield Enhancement-Cotton

| <u>Compound</u> <u>No.</u> | <u>Concentration</u> <u>(gm/plot)</u> | <u>Application Timing*</u> | <u>Actual Yield</u> <u>(gm/plot)</u> |
|-------------------------------|--|-------------------------------|---|
| Control | - | - | 984.5 |
| 44 | 0.78 | Bloom (T_1) | 1081.0 |
| | 1.55 | Bloom (T_1) | 1160.4 |
| | 3.10 | Bloom (T_1) | 1175.3 |
| 44 | 0.78 | 3 Weeks after Bloom (T_2) | 1057.8 |
| | 3.10 | 3 Weeks after Bloom (T_2) | 1065.1 |

*First application at bloom (T_1), 47 days after planting; second application at 3 weeks after bloom (T_2), 67 days after planting; and harvesting occurred 126 days after planting.

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The results in Table HH demonstrate that treatment of cotton with a representative heterocyclic nitrogen-containing compound, i.e., Compound 44, in accordance with the method of this invention significantly increases cotton crop yield in comparison with untreated control cotton crops at similar conditions.

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Example CLXXIV

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Crop Yield Enhancement - Sweet Potatoes

Agronomic uses of compounds having antitranspirant activity include not only water conservation but also crop yield enhancement. As an illustration, an antitranspirant compound applied to a crop may increase actual crop yields by reducing water loss during periods of critical water need. As used in Table II below, crop yield enhancement was determined for sweet potatoes according to the following general procedure:

Solutions of Compound 44 were prepared by dissolving either 0.78 grams, 1.55 grams or 3.10 grams of the compound into 780 milliliters of acetone. Just prior to the time of application, water was added to each of the above solutions to a final volume of 1300 milliliters. Solutions of a control having no test compound were also prepared by mixing 780 milliliters of acetone and 520 milliliters of water to a total volume of 1300 milliliters.

The above formulations were applied to sweet potatoes by utilizing a statistical treatment procedure involving separate plots. Each plot consisted of 4 rows individually 20 feet in length and about 3 feet between rows. Each experiment was designed as a randomized complete block of six different repetitions in which each repetition included the following: (1) treatment with control having no test compound; (2) treatment with 0.78

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grams/plot of Compound 44 at time T_1 designated in Table II; (3) treatment with 1.55 grams/plot of Compound 44 at time T_1 designated in Table II; (4) treatment with 3.10 grams/plot of Compound 44 at time T_1 designated in Table II; (5) treatment with 0.78 grams/plot of Compound 44 at time T_2 designated in Table II; and (6) treatment with 1.55 grams/plot of Compound 44 at time T_2 designated in Table II. The above formulations were applied to each plot by use of a carbon dioxide backpack sprayer set at about 20-40 psig air pressure. The planting, application and harvesting times for the sweet potatoe crop are detailed in Table II. The harvested sweet potatoe crops for yield determination included the inner 10 feet of the middle 2 rows in each plot (5 feet in from ends of the middle 2 rows). Water stress conditions existed to a degree during at least a portion of the growing period. The values obtained for each plot in each repetition were averaged to obtain the results in Table II.

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TABLE II
Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Crop Yield Enhancement-Sweet Potatoes

| <u>Compound</u> <u>No.</u> | <u>Concentration</u> <u>(gm/plot)</u> | <u>Application Timing*</u> | <u>Actual Yield</u> <u>(kg/plot)</u> |
|-------------------------------|--|---|---|
| Control | - | - | 95.48 |
| 44 | 0.78 | Tuber Initiation (T_1) | 111.10 |
| | 1.55 | Tuber Initiation (T_1) | 99.88 |
| | 3.10 | Tuber Initiation (T_1) | 99.88 |
| 44 | 0.78 | 4 Weeks after Tuber Initiation (T_2) | 107.36 |
| | 1.55 | 4 Weeks after Tuber Initiation (T_2) | 98.78 |

*First application at tuber initiation (T_1), 43 days after transplanting; second application at 4 weeks after tuber initiation (T_2), 77 days after transplanting; and harvesting occurred 140 days after transplanting.

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The results in Table II demonstrate that treatment of sweet potatoes with a representative heterocyclic nitrogen-containing compound, i.e., Compound 44, in accordance with the method of this invention significantly increases sweet potatoe crop yield in comparison with untreated control sweet potatoe crops at similar conditions.

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Example CLXXVEffect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Crop Yield Enhancement - Soybeans

Agronomic uses of compounds having antitranspirant activity include not only water conservation but also crop yield enhancement. As an illustration, an antitranspirant compound applied to a crop may increase actual crop yields by reducing water loss during periods of critical water need. As used in Table JJ below, crop yield enhancement was determined for soybeans according to the following general procedure:

Solutions of Compound 44 were prepared by dissolving either 0.78 grams, 1.55 grams or 3.10 grams of the compound into 780 milliliters of acetone. Just prior to the time of application, water was added to each of the above solutions to a final volume of 1300 milliliters. Solutions of a control having no test compound were also prepared by mixing 780 milliliters of acetone and 520 milliliters of water to a total volume of 1300 milliliters.

The above formulations were applied to soybeans by utilizing a statistical treatment procedure involving 36 separate plots. Each plot consisted of 4 rows individually 20 feet in length and about 3 feet between rows. Each experiment was designed as a randomized complete block of six different repetitions in which each repetition included the following: (1) treatment with control having no test compound; (2) treatment with 1.55

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grams/plot of Compound 44 at time T_1 designated in Table JJ; (3) treatment with 3.10 grams/plot of Compound 44 at time T_1 designated in Table JJ; (4) treatment with 0.78 grams/plot of Compound 44 at time T_2 designated in Table JJ; (5) treatment with 1.55 grams/plot of Compound 44 at time T_2 designated in Table JJ; and (6) treatment with 3.10 grams/plot of Compound 44 at time T_2 designated in Table JJ. The above formulations were applied to each plot by use of a carbon dioxide backpack sprayer set at about 20-40 psig air pressure. The planting, application and harvesting times for the soybean crop are detailed in Table JJ. The harvested soybean crop for yield determination included the inner 10 feet of the middle 2 rows in each plot (5 feet in from ends of the middle 2 rows). Water stress conditions existed to a degree during at least a portion of the growing period. The values obtained for each plot in each repetition were averaged to obtain the results in Table JJ.

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TABLE JJ
Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Crop Yield Enhancement-Soybeans

| <u>Compound</u> <u>No.</u> | <u>Concentration</u> <u>(gm/plot)</u> | <u>Application Timing*</u> | <u>Actual Yield</u> <u>(kg/plot)</u> |
|-------------------------------|--|-----------------------------------|---|
| Control | - | - | 0.48 |
| 44 | 1.55 | Flowering (T_1) | 0.55 |
| | 3.10 | Flowering (T_1) | 0.55 |
| 44 | 0.78 | 3 Weeks after Flowering (T_2) | 0.58 |
| | 1.55 | 3 Weeks after Flowering (T_2) | 0.60 |
| | 3.10 | 3 Weeks after Flowering (T_2) | 0.52 |

*First application at flowering (T_1), 63 days after planting;
second application at 3 weeks after flowering (T_2), 86 days after
planting; and harvesting occurred 201 days after planting.

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The results in Table JJ demonstrate that treatment of soybeans with a representative heterocyclic nitrogen-containing compound, i.e., Compound 44, in accordance with the method of this invention significantly increases soybean crop yield in comparison with untreated control soybean crops at similar conditions.

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Example CLXXVI
Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Crop Yield Enhancement - Cotton and Potatoes

Agronomic uses of compounds having antitranspirant activity include not only water conservation but also crop yield enhancement. As an illustration, an antitranspirant compound applied to a crop may increase actual crop yields by reducing water loss during periods of critical water need. As used in Tables KK and LL below, crop yield enhancement was determined for cotton and potatoes according to the following general procedure:

An emulsifiable concentrate of Compound 44 was prepared containing 39.3 weight percent of propylene carbonate, 39.3 weight percent of Exxate 700 (Exxon Chemicals, Houston, Texas), 10.0 weight percent of Atlox 3455F (ICI Americas, Wilmington, Delaware) and 11.4 weight percent of Compound 44. Just prior to the time of application, 31 milliliters (3.5 grams of Compound 44) or 62 milliliters (7.0 grams of Compound 44) of the above emulsifiable concentrate was added to water to a final volume of 3125 milliliters.

The above formulations were applied to the particular crop designated in Tables KK and LL by utilizing a statistical treatment procedure involving 30 separate plots. Each plot consisted of 4 rows individually 30 feet in length and about 3 feet between rows. Each experiment was designed as a randomized complete block of six different repetitions in which each repetition included the

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following: (1) treatment with control having no test compound; (2) treatment with 3.5 grams/plot of Compound 44 at time T_1 designated in Table KK and LL; (3) treatment with 7.0 grams/plot of Compound 44 at time T_1 designated in Tables KK and LL; (4) treatment with 3.5 grams/plot of Compound 44 at time T_2 designated in Tables KK and LL; and (5) treatment with 7.0 grams/plot of Compound 44 at time T_2 designated in Tables KK and LL. The above formulations were applied to each plot by use of a carbon dioxide backpack sprayer set at about 20-40 psig air pressure. The planting, application and harvesting times for each crop are detailed in Tables KK and LL. The harvested crops for yield determination included the inner 20 feet of the middle 2 rows in each plot (5 feet in from ends of the middle 2 rows). Water stress conditions existed to a degree during at least a portion of the growing period. The values obtained for each plot in each repetition were averaged to obtain the results in Tables KK and LL.

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TABLE KK
Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Crop Yield Enhancement-Cotton

| <u>Compound</u> <u>No.</u> | <u>Concentration</u> <u>(gm/plot)</u> | <u>Application Timing*</u> | <u>Actual Yield</u> <u>(kg/plot)</u> |
|-------------------------------|--|----------------------------------|---|
| Control | - | - | 3.18 |
| 44 | 3.5 | Two weeks before Bloom (T_1) | 3.49 |
| | 7.0 | Two weeks before Bloom (T_1) | 3.48 |
| 44 | 3.5 | Bloom (T_2) | 3.61 |
| | 7.0 | Bloom (T_2) | 3.35 |

*First application at two weeks before bloom (T_1), 61 days after planting; second application at bloom (T_2), 73 days after planting; and harvesting occurred 167 days after planting.

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TABLE LL
Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Crop Yield Enhancement-Potatoes

| <u>Compound</u> <u>No.</u> | <u>Concentration</u> <u>(gm/plot)</u> | <u>Application Timing*</u> | <u>Actual Yield</u> <u>(kg/plot)</u> |
|-------------------------------|--|--------------------------------------|---|
| Control | - | - | 9.01 |
| 44 | 3.5 | Flowering (T_1) | 10.94 |
| | 7.0 | Flowering (T_1) | 10.23 |
| 44 | 3.5 | 3 Weeks after Flowering (T_2) | 10.30 |
| | 7.0 | 3 Weeks after Flowering (T_2) | 9.87 |

*First application at flowering (T_1), 75 days after planting;
second application at 3 weeks after flowering (T_2), 96 days after
planting; and harvesting occurred 125 days after planting.

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The results in Tables KK and LL demonstrate that treatment of cotton and potatoes with a representative heterocyclic nitrogen-containing compound, i.e., Compound 44, in accordance with the method of this invention significantly increases crop yield in comparison with untreated control crops at similar conditions.

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Example CLXXVIIEffect of Representative HeterocyclicNitrogen-Containing Compounds onCrop Yield Enhancement - Soybeans

Agronomic uses of compounds having antitranspirant activity include not only water conservation but also crop yield enhancement. As an illustration, an antitranspirant compound applied to a crop may increase actual crop yields by reducing water loss during periods of critical water need. As used in Table MM below, crop yield enhancement was determined for soybeans according to the following general procedure:

An emulsifiable concentrate of Compound 44 was prepared containing 39.3 weight percent of propylene carbonate, 39.3 weight percent of Exxate 700 (Exxon Chemicals, Houston, Texas), 10.0 weight percent of Atlox 3455F (ICI Americas, Wilmington, Delaware) and 11.4 weight percent of Compound 44. Just prior to the time of application, 31 milliliters (3.5 grams Compound 44) or 62 milliliters (7.0 grams Compound 44) of the above emulsifiable concentrate was added to water to a final volume of 3125 milliliters.

The above formulations were applied to the soybeans by utilizing a statistical treatment procedure involving 18 separate plots. Each plot consisted of 4 rows individually 30 feet in length and about 3 feet between rows. Each experiment was designed as a randomized complete block of six different repetitions in which each repetition included the following: (1) treatment with control

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having no test compound; (2) treatment with 3.5 grams/plot of Compound 44 at time T_1 designated in Table MM; and (3) treatment with 7.0 grams/plot of Compound 44 at time T_1 designated in Table MM. The above formulations were applied to each plot by use of a carbon dioxide backpack sprayer set at about 20-40 psig air pressure. The planting, application and harvesting times for the soybean crop are detailed in Table MM. The harvested soybean crop for yield determination included the inner 20 feet of the middle 2 rows in each plot (5 feet in from ends of the middle 2 rows). Water stress conditions existed to a degree during at least a portion of the growing period. The values obtained for each plot in each repetition were averaged to obtain the results in Table MM.

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TABLE MM
Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Crop Yield Enhancement-Soybeans

| <u>Compound</u> <u>No.</u> | <u>Concentration</u> <u>(gm/plot)</u> | <u>Application Timing*</u> | <u>Actual Yield</u> <u>(kg/plot)</u> |
|-------------------------------|--|----------------------------|---|
| Control | - | - | 6.29 |
| 44 | 3.5 | Flowering (T_1) | 6.87 |
| | 7.0 | Flowering (T_1) | 6.50 |

*First application at flowering (T_1). 48 days after planting; and harvesting occurred 186 days after planting.

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The results in Table MM demonstrate that treatment of soybeans with a representative heterocyclic nitrogen-containing compound, i.e., Compound 44, in accordance with the method of this invention significantly increases soybean crop yield in comparison with untreated control soybean crops at similar conditions.

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Example CLXXVIII

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Crop Yield Enhancement - Alfalfa

The effect of representative heterocyclic nitrogen-containing compounds on crop yield enhancement was also determined for alfalfa according to the following general procedure:

Solutions of Compound 44 were prepared by dissolving either 6.60 grams or 13.20 grams of the compound into 3300 milliliters of acetone. Just prior to the time of application, water was added to each of the above solutions to a final volume of 5500 milliliters. Solutions of a control having no test compound were also prepared by mixing 3300 milliliters of acetone and 2200 milliliters of water to a total volume of 5500 milliliters.

The above formulations were applied to designated plots of one year old established alfalfa crop by utilizing a self-propelled chemical spray applicator set at 40 psig air pressure. Each plot had the following dimensions: 20 feet in width by 30 feet in length. Each treatment including the controls consisted of 6 replications on 6 separate plots. The above formulations were applied 20 days following a cutting and the alfalfa was harvested 28 days following the treatment. The harvested alfalfa crop for yield determination included a one square meter area from the center of each plot. Water stress conditions existed to a degree during at

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least a portion of the growing period. The values obtained for each plot in each repetition were averaged to obtain the results in Table NN below.

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TABLE NN
Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Crop Yield Enhancement-Alfalfa

| Compound No. | Concentration (gm/plot) | Actual Yield | |
|-----------------|----------------------------|---------------------------------------|--------------------------------------|
| | | Fresh Weight* (gm/m ²) | Dry Weight** (gm/m ²) |
| Control | - | 301.2 | 128.2 |
| 44 | 6.60 | 331.2 | 146.7 |
| | 13.20 | 342.8 | 153.2 |

*Fresh weight was determined by weighing the alfalfa immediately after harvest.

**Dry weight was determined by drying the harvested alfalfa in an oven at 90°C for 24 hours and then weighing the dried alfalfa.

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The results in Table NN demonstrate that treatment of alfalfa with a representative heterocyclic nitrogen-containing compound, i.e., Compound 44, in accordance with the method of this invention significantly increases alfalfa crop yield in comparison with untreated control alfalfa crops.

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Example CLXXIXEffect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Photosynthetic Electron Transport

Because the two photosystems, i.e., Photosystems I and II, involved in plant photosynthesis are interconnected by an electron transport chain, the use of artificial electron donors and acceptors allows the study of specific partial reactions of the light reactions of photosynthesis. In accordance with the procedure described in Brewer, P.E., Arntzen, C.J., and Slife, F.W., Weed Science 27: 300-308 (1979), an isolated chloroplast assay was used to determine the degree of photosynthetic inhibition caused by the compounds identified in Table OO. In general, the procedure involved osmotically disrupting isolated pea chloroplasts, placing the chloroplasts in a reaction mixture and utilizing methylviologen as the terminal electron acceptor. Oxygen consumption was measured using a Clark electrode attached to a Gilson auxograph. The results in Table OO are reported as percent inhibition compared to an untreated control.

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TABLE OO

Effect of Representative Heterocyclic
Nitrogen-Containing Compounds on
Photosynthetic Electron Transport

| <u>Compound</u> <u>No.</u> | <u>Concentration</u> <u>(g/liter)</u> | <u>Percent Inhibition</u> <u>(Oxygen Uptake)</u> |
|-------------------------------|---|--|
| Control | 0 | 0 |
| 44 | 622 | 0 |
| 93 | 650 | 0 |
| Atrazine | 108 | 65 |
| Diuron | 47 | 55 |

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The results in Table OO demonstrate that compounds used in this invention cause no inhibition of photosynthetic electron transport whereas atrazine and diuron both cause substantial inhibition of photosynthetic electron transport.

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Although the invention has been illustrated by the preceding examples, it is not to be construed as being limited thereby; but rather, the invention encompasses the generic area as hereinbefore disclosed. Various modifications and embodiments can be made without departing from the spirit and scope thereof.

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Claims

1. A method of reducing moisture loss from plants which comprises applying to the plant surface an effective amount, sufficient to reduce moisture loss from the plant surface without substantially inhibiting plant photosynthetic electron transport, of a compound having the formula:



wherein:

R_1 is a substituted or unsubstituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryl dialkylsilyloxy, triaryl silyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl.

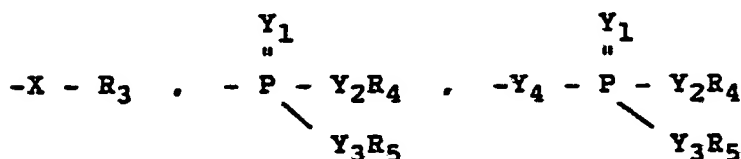
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polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio,

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alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3.$



or



R_1 is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl,

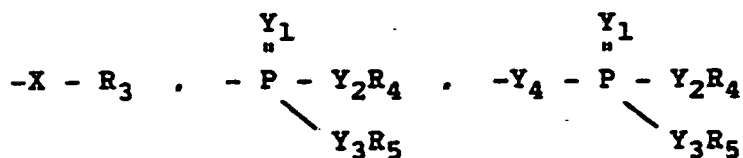
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alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy-sulfonyl, polyhaloalkoxy-sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxy-carbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxy-carbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxy-carbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide,

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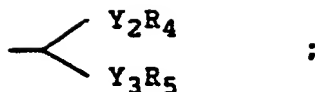
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
 aryloxy, aralkoxy, arylthio, aralkylthio,
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R₃, = X-R₃,



or

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X is a covalent single bond or double bond, a substituted or unsubstituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl,

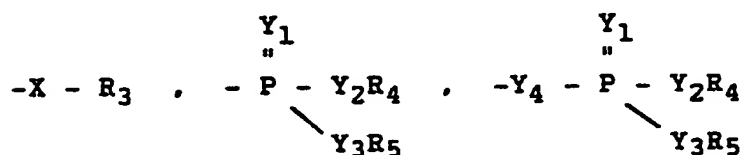
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aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl,

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alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
dialkoxyphosphino, hydroxyamino, alkoxyamino,
aryloxyamino, aryloxyimino, oxo, thiono,
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R₃, = X-R₃,



or



R₂ is a substituted or unsubstituted, heterocyclic ring system having at least one nitrogen atom which is selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl,

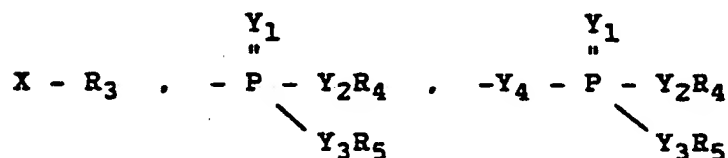
- 588 -

dialkylaminocarbonyl, aminothiocarbonyl,
alkylaminothiocarbonyl, dialkylaminothiocarbonyl,
nitro, cyano, hydroxycarbonyl and derivative salts
formamido, alkyl, alkoxy, polyhaloalkyl,
polyhaloalkoxy, alkoxycarbonyl, substituted amino in
which the permissible substituents are the same or
different and are one or two propargyl, alkoxyalkyl,
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or
polyhaloalkenyl; alkylthio, polyhaloalkylthio,
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,
polyhaloalkylsulfonyl, alkylsulfonylamino,
alkylcarbonylamino, polyhaloalkylsulfonylamino,
polyhaloalkylcarbonylamino, trialkylsilyl,
aryldialkylsilyl, triarylsilyl, sulfonic acid and
derivative salts, phosphonic acid and derivative
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,
polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
arylloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy.

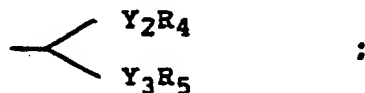
- 589 -

aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R₃, = X-R₃.



or



wherein:

R₃ is a substituted or unsubstituted,
 carbocyclic or heterocyclic ring system selected
 from a monocyclic aromatic or nonaromatic ring

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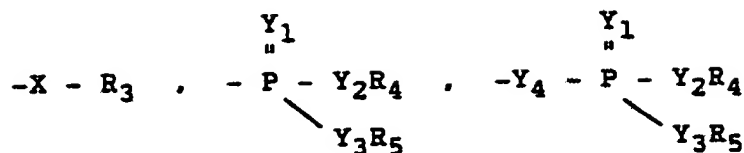
system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy.

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polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl,
dialkylaminosulfonyl, arylaminosulfonyl,
carboxyalkoxy, carboxyalkylthio,
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
alkenylsulfonyloxy, arylsulfonyloxy,
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
aroylamino, haloacylamino, alkoxycarbonyloxy,
arylsulfonylamino, aminocarbonyloxy, cyanato,
isocyanato, isothiocyano, cycloalkylamino,
trialkylammonium, arylamino, aryl(alkyl)amino,
aralkylamino, alkoxyalkylphosphinyl,
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
dialkoxyphosphino, hydroxyamino, alkoxyamino,
aryloxyamino, aryloxyimino, oxo, thiono,
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

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$-X, = X, -X = R_3, = X-R_3,$



or



R_3 is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio,

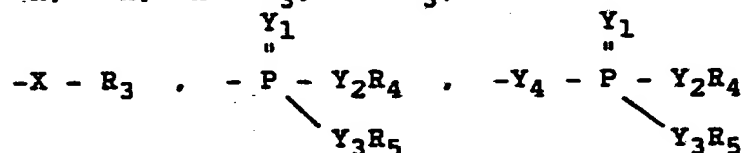
- 593 -

alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy.

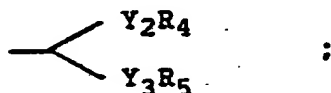
- 594 -

arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



Y_1 and Y_4 are independently oxygen or sulfur;

Y_2 and Y_3 are independently oxygen, sulfur, amino or a covalent bond; and

R_4 and R_5 are independently hydrogen or substituted or unsubstituted alkyl, polyhaloalkyl, phenyl or benzyl in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxyalkyl, alkoxyalkylthio, polyhaloalkenylthio, thiocyanato, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy,

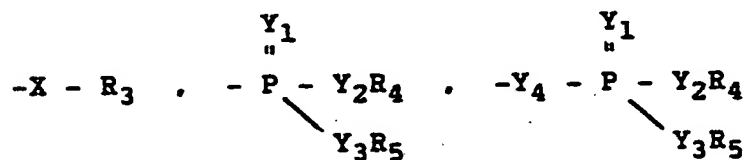
- 595 -

triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl,

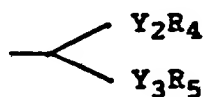
- 596 -

arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyposphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R₃, = X-R₃.

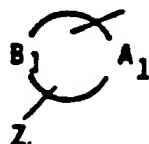


or

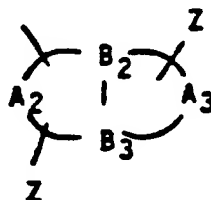


- 597 -

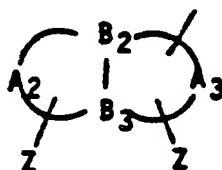
2. The method of claim 1 wherein R_1 and R_3 are independently a substituted or unsubstituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system having the formula



a bicyclic aromatic or nonaromatic ring system having the formula selected from

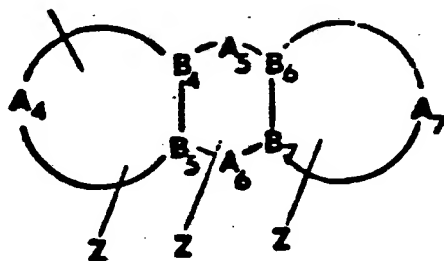
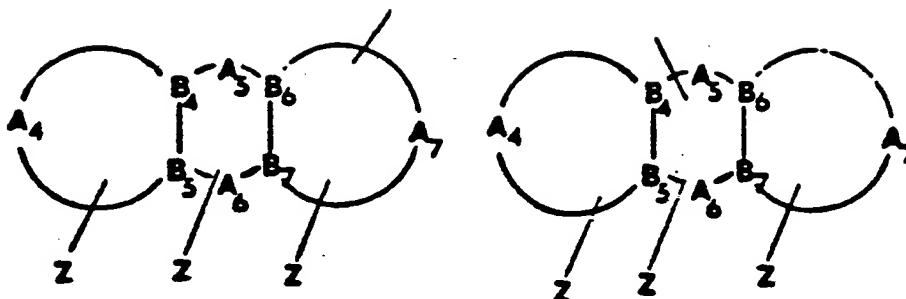


and

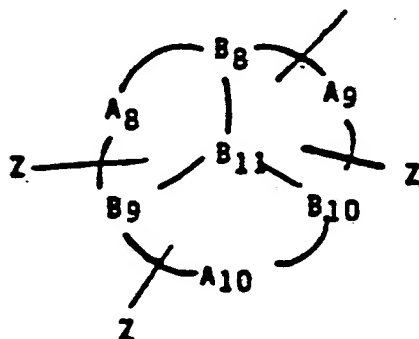


a polycyclic aromatic or nonaromatic ring system having the formula selected from

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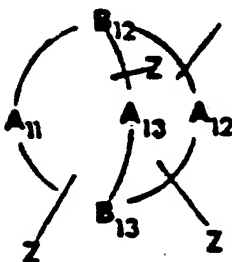
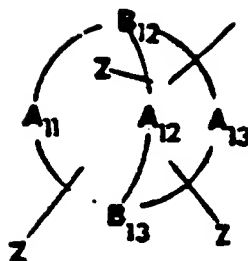


and

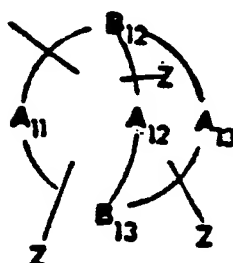


and a bridged ring system which may be saturated or unsaturated having the formula selected from

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and



wherein:

A_1 represents a ring-forming chain of atoms which together with B_1 forms a carbocyclic or heterocyclic ring system containing from 0 to 4 double bonds or from 0 to 2 triple bonds;

B_1 represents a saturated or unsaturated carbon atom;

A_2 and A_3 independently represent a ring-forming chain of atoms which together with B_2 and B_3 form a carbocyclic or heterocyclic ring system;

B_2 and B_3 are independently a saturated or unsaturated carbon atom or a saturated nitrogen atom;

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A₄, A₅, A₆ and A₇ independently represent a ring-forming chain of atoms which together with B₄, B₅, B₆ and B₇ form a carbocyclic or heterocyclic ring system;

B₄, B₅, B₆ and B₇ are independently a saturated or unsaturated carbon atom or a saturated nitrogen atom;

A₈, A₉ and A₁₀ independently represent a ring-forming chain of atoms which together with B₈, B₉, B₁₀ and B₁₁ form a carbocyclic or heterocyclic ring system;

B₈, B₉ and B₁₀ are independently a saturated or unsaturated carbon atom or a saturated nitrogen atom;

B₁₁ represents a saturated or unsaturated carbon atom, nitrogen atom or phosphorous atom;

A₁₁, A₁₂ and A₁₃ independently represent a ring-forming chain of atoms which together with B₁₂ and B₁₃ form a carbocyclic or heterocyclic ring system;

B₁₂ and B₁₃ are independently a saturated carbon atom or a nitrogen atom; and

Z is the same or different and is one or more of hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl,

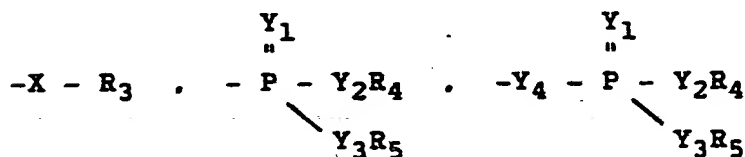
- 601 -

dialkylaminocarbonyl, aminothiocarbonyl,
alkylaminothiocarbonyl, dialkylaminothiocarbonyl,
nitro, cyano, hydroxycarbonyl and derivative salts
formamido, alkyl, alkoxy, polyhaloalkyl,
polyhaloalkoxy, alkoxycarbonyl, substituted amino in
which the permissible substituents are the same or
different and are one or two propargyl, alkoxyalkyl,
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or
polyhaloalkenyl; alkylthio, polyhaloalkylthio,
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,
polyhaloalkylsulfonyl, alkylsulfonylamino,
alkylcarbonylamino, polyhaloalkylsulfonylamino,
polyhaloalkylcarbonylamino, trialkylsilyl,
aryldialkylsilyl, triarylsilyl, sulfonic acid and
derivative salts, phosphonic acid and derivative
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,
polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy.

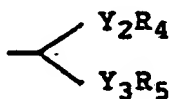
- 602 -

aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxylalkylphosphinyl,
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxylphosphino, hydroxyamino, alkoxylamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R₃, = X-R₃,



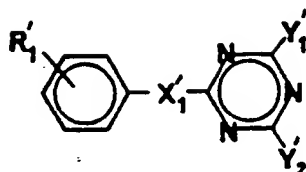
or



wherein R₃, R₄, R₅, Y₁, Y₂, Y₃, Y₄ and
 X are as defined in claim 1.

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3. The method of claim 1 in which the compound has the formula



wherein:

R'₁ is the same or different and is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio,

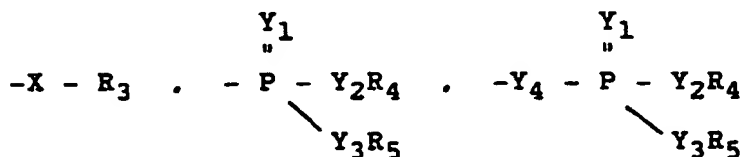
- 604 -

alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy,

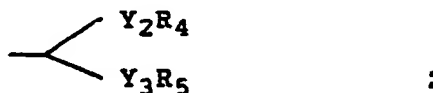
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arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium.

$-X, = X, -X = R_3, = X-R_3,$



or



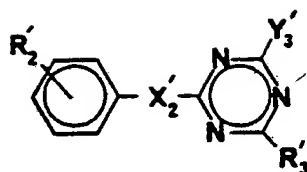
X'_1 is O, S, SO, SO₂, NH, CH₂, CO, a single covalent bond, CH₂O, CH₂S, -CH(CH₃)O, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -CH₂CH₂-, -C≡C-, -CH₂SO-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)- or -CONH-; and

Y'_1 and Y'_2 are independently halogen, alkyl or alkoxy;

wherein X, R₃, R₄, R₅, Y₁, Y₂, Y₃ and Y₄ are as defined in claim 1.

4. The method of claim 1 in which the compound has the formula

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wherein:

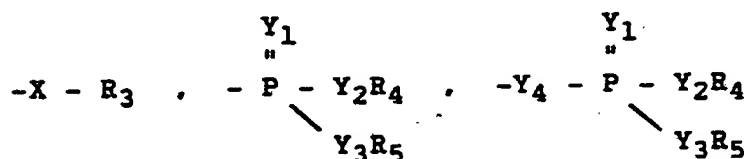
R'₂ and R'₃ are the same or different and R'₂ is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxyalkyl, alkoxyalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxyalkyl, polyhaloalkoxy, alkoxyalkyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfanyl, polyhaloalkylsulfanyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl.

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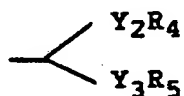
aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl,

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alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,
 $-X_1 = X$, $-X = R_3$, $-X = X-R_3$.



or

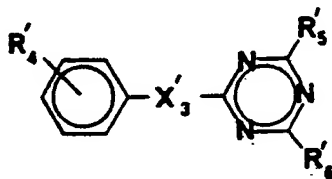


X'_2 is O, S, SO, SO₂, NH, CH₂, CO, a
 single covalent bond, -CH(CH₃)O-, -CH(CN)O-,
 -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -C≡C-,
 -CH₂SO-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)-
 or -CONH-; and

Y'_3 is halogen;

wherein X, R₃, R₄, R₅, Y₁, Y₂, Y₃ and
 Y₄ are as defined in claim 1.

5. The method of claim 1 in which the
 compound has the formula



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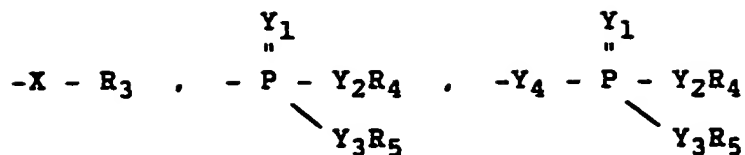
wherein:

R'₄, R'₅ and R'₆ are the same or different and R'₄ is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxy carbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxy carbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,

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polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl,
dialkylaminosulfonyl, arylaminosulfonyl,
carboxyalkoxy, carboxyalkylthio,
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
alkenylsulfonyloxy, arylsulfonyloxy,
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
aroylamino, haloacylamino, alkoxycarbonyloxy,
arylsulfonylamino, aminocarbonyloxy, cyanato,
isocyanato, isothiocyano, cycloalkylamino,
trialkylammonium, arylamino, aryl(alkyl)amino,
aralkylamino, alkoxyalkylphosphinyl,
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
dialkoxyposphino, hydroxyamino, alkoxyamino,
aryloxyamino, aryloxyimino, oxo, thiono,
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

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$$-X, = X, -X = R_3, = X-R_3,$$


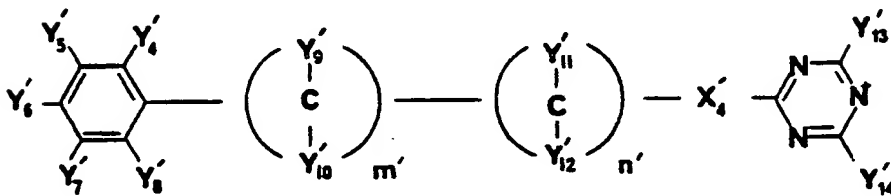
or



X'_3 is O, S, SO, SO₂, NH, CH₂, CO, a single covalent bond, -CH(CH₃)O-, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -C≡C-, -CH₂SO-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)- or -CONH-;

wherein X, R₃, R₄, R₅, Y₁, Y₂, Y₃ and Y₄ are as defined in claim 1.

6. The method of claim 1 in which the compound has the formula



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wherein:

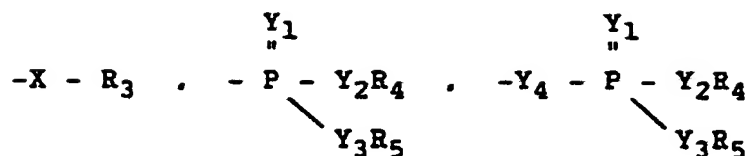
Y'₄, Y'₅, Y'₆, Y'₇ and Y'₈ are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxy carbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxy carbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxy carbonylhydrazonomethyl,

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alkoxyiminomethyl, unsubstituted or substituted
 aryloxyiminomethyl, hydrazonomethyl, unsubstituted
 or substituted arylhydrazonomethyl, a hydroxy group
 condensed with a mono-, di- or polysaccharide,
 haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
 aryloxy, aralkoxy, arylthio, aralkylthio,
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyposphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$$-X, \equiv X, -X = R_3, = X-R_3,$$

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or



Y'_9 , Y'_{10} , Y'_{11} and Y'_{12} are the same or different and are hydrogen, halogen, alkyl, polyhaloalkyl, cyano or aryl;

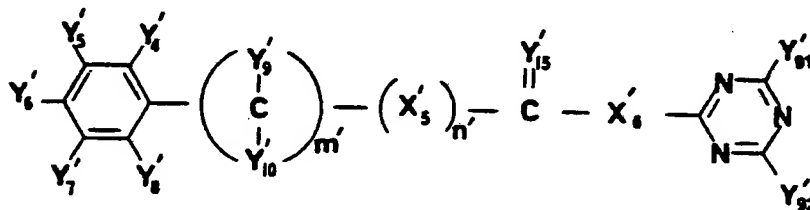
m' and n' are the same or different and are a value of from 0 to 5;

X'_4 is O, S, SO, SO₂, NH, CH₂, CO, a single covalent bond, -CH(CH₃)O-, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -C≡C-, -CH₂SO-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)- or -CONH-; and

Y'_{13} and Y'_{14} are the same or different and are halogen, alkyl or alkoxy;

wherein X, R₃, R₄, R₅, Y₁, Y₂, Y₃ and Y₄ are as defined in claim 1.

7. The method of claim 1 in which the compound has the formula



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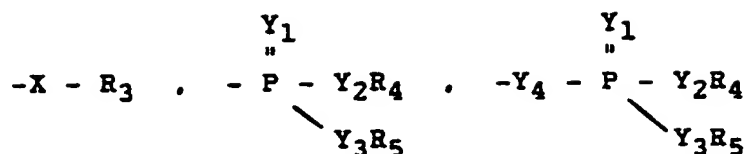
wherein:

Y'₄, Y'₅, Y'₆, Y'₇ and Y'₈ are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,

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polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl,
dialkylaminosulfonyl, arylaminosulfonyl,
carboxyalkoxy, carboxyalkylthio,
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
alkenylsulfonyloxy, arylsulfonyloxy,
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
aroylamino, haloacylamino, alkoxycarbonyloxy,
arylsulfonylamino, aminocarbonyloxy, cyanato,
isocyanato, isothiocyano, cycloalkylamino,
trialkylammonium, arylamino, aryl(alkyl)amino,
aralkylamino, alkoxyalkylphosphinyl,
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
dialkoxyphosphino, hydroxyamino, alkoxyamino,
aryloxyamino, aryloxyimino, oxo, thiono,
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

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or



Y'_9 and Y'_{10} are the same or different and are hydrogen, halogen, alkyl, polyhaloalkyl, cyano or aryl;

m' and n' are the same or different and are a value of from 0 to 5;

X'_5 is the same or different and is O, S, SO, SO₂, NH, CH₂, CO, a single covalent bond, -CH(CH₃)O-, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -C≡C-, -CH₂SO-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)- or -CONH-;

Y'_{15} is O or S;

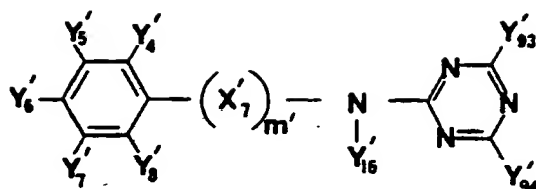
Y'_{91} and Y'_{92} are independently halogen; and

X'_6 is O or S;

wherein X, R₃, R₄, R₅, Y₁, Y₂, Y₃ and Y₄ are as defined in claim 1.

8. The method of claim 1 in which the compound has the formula

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wherein:

Y'₄, Y'₅, Y'₆, Y'₇ and Y'₈ are the same as different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocabonyl, dialkylaminothiocabonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxy carbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino,

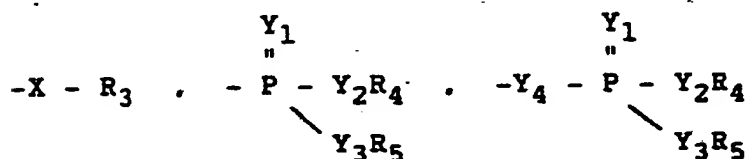
- 619 -

alkylcarbonylamino, polyhaloalkylsulfonylamino,
polyhaloalkylcarbonylamino, trialkylsilyl,
aryldialkylsilyl, triarylsilyl, sulfonic acid and
derivative salts, phosphonic acid and derivative
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,
polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxylalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
aroyle, haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl,
dialkylaminosulfonyl, arylaminosulfonyl,
carboxylalkoxy, carboxylalkylthio,
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
alkenylsulfonyloxy, arylsulfonyloxy,
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
aroyleamino, haloacylamino, alkoxycarbonyloxy,
arylsulfonylamino, aminocarbonyloxy, cyanato,
isocyanato, isothiocyano, cycloalkylamino,

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trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl, alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl, dialkoxyphosphino, hydroxyamino, alkoxyamino, aryloxyamino, aryloxyimino, oxo, thiono, alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy, alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



X'_7 is the same or different and is O, S, SO, SO₂, NH, CH₂, CO, a single covalent bond, -CH(CH₃)O-, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -C≡C-, -CH₂SO-, -CH₂SO₂-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)- or -CONH-;

m' is a value of from 0 to 5;

Y'_{16} is hydrogen, alkyl, alkylcarbonyl, alkylsulfonyl, or polyhaloalkylsulfonyl; and

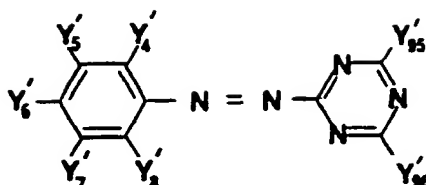
Y'_{93} and Y'_{94} are independently halogen;

wherein X, R₃, R₄, R₅, Y₁, Y₂, Y₃ and

Y₄ are as defined in claim 1.

9. The method of claim 1 in which the compound has the formula

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wherein:

Y'₄, Y'₅, Y'₆, Y'₇ and Y'₈ are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothi carbonyl, alkylaminothi carbonyl, dialkylaminothi carbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxy carbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino.

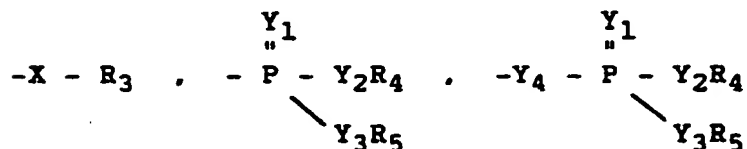
- 622 -

alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino,

- 623 -

trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3.$

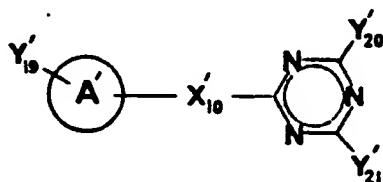


or



Y'_{95} and Y'_{96} are independently halogen;
 wherein $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$ and
 Y_4 are as defined in claim 1.

10. The method of claim 1 in which the
 compound has the formula



wherein:

Y'_{19} and Y'_{21} are the same or different
 and Y'_{19} is one or more hydrogen, halogen,
 alkylcarbonyl, alkylcarbonylalkyl,

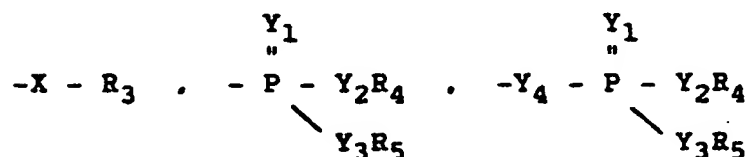
- 624 -

alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocabonyl, dialkylaminothiocabonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide,

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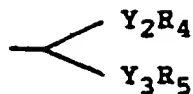
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
 aryloxy, aralkoxy, arylthio, aralkylthio,
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3.$



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or



A' is as defined for R₁ in claim 1;

X'₁₀ is as defined for X in claim 1; and

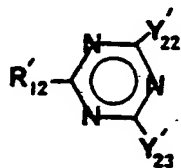
Y'₂₀ is halogen, cyano, alkyl, alkoxy,

polyhaloalkyl, polyhaloalkoxy, or

polyhaloalkylsulfonyloxy;

wherein X, R₃, R₄, R₅, Y₁, Y₂, Y₃ and Y₄ are as defined in claim 1.

11. The method of claim 1 in which the compound has the formula



wherein:

R'₁₂ is as defined for R₁ in claim 1;

Y'₂₂ is halogen, cyano, alkyl, alkoxy,

polyhaloalkyl, polyhaloalkoxy, or

polyhaloalkylsulfonyloxy; and

Y'₂₃ is hydrogen, halogen, alkylcarbonyl,

alkylcarbonylalkyl, alkoxyalkylalkyl,

alkoxyalkylalkylthio, polyhaloalkenylthio,

thiocyano, propargylthio, hydroxyimino, alkoxyimino,

trialkylsilyloxy, aryldialkylsilyloxy,

triarylsilyloxy, formamidino, alkylsulfamido,

dialkylsulfamido, alkoxyalkylsulfonyl,

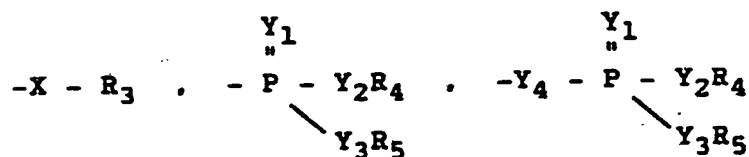
polyhaloalkoxyalkylsulfonyl, hydroxy, amino,

- 627 -

aminocarbonyl, alkylaminocarbonyl,
dialkylaminocarbonyl, aminothiocarbonyl,
alkylaminothiocarbonyl, dialkylaminothiocarbonyl,
nitro, cyano, hydroxycarbonyl and derivative salts
formamido, alkyl, alkoxy, polyhaloalkyl,
polyhaloalkoxy, alkoxycarbonyl, substituted amino in
which the permissible substituents are the same or
different and are one or two propargyl, alkoxyalkyl,
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or
polyhaloalkenyl; alkylthio, polyhaloalkylthio,
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,
polyhaloalkylsulfonyl, alkylsulfonylamino,
alkylcarbonylamino, polyhaloalkylsulfonylamino,
polyhaloalkylcarbonylamino, trialkylsilyl,
aryldialkylsilyl, triarylsilyl, sulfonic acid and
derivative salts, phosphonic acid and derivative
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,
polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,

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alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,
 $-X$, $= X$, $-X = R_3$, $= X-R_3$.



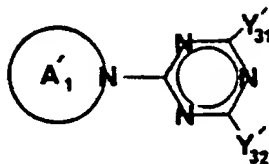
or



wherein X , R_3 , R_4 , R_5 , Y_1 , Y_2 , Y_3 and
 Y_4 are as defined in claim-1.

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12. The method of claim 1 in which the compound has the formula



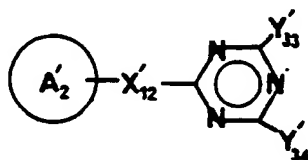
wherein:

A'_1 is as defined for R_2 in claim 1;

and

Y'_{31} and Y'_{32} are the same or different and are halogen, alkyl or alkoxy.

13. The method of claim 1 in which the compound has the formula



wherein:

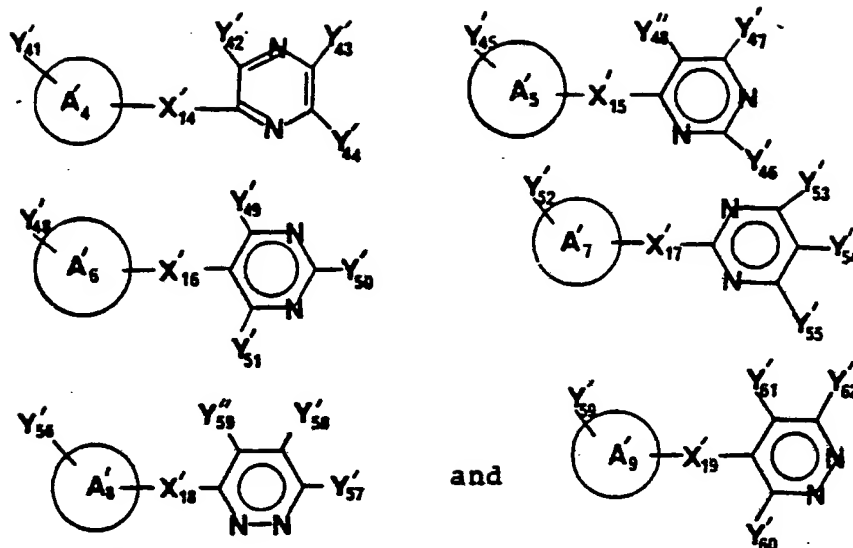
A'_2 is as defined for R_1 in claim 1;

X'_{12} is as defined for X in claim 1; and

Y'_{33} and Y'_{34} are the same or different and are halogen, alkyl or alkoxy.

14. The method of claim 1 in which the compound has the formula selected from

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wherein:

$Y'_{41}, Y'_{42}, Y'_{43}, Y'_{44}, Y'_{45},$
 $Y'_{46}, Y'_{47}, Y'_{48}, Y'_{49}, Y'_{50}, Y'_{51},$
 $Y'_{52}, Y'_{53}, Y'_{54}, Y'_{55}, Y'_{56},$
 $Y'_{57}, Y'_{58}, Y'_{59}, Y'_{60}, Y'_{61}$ and
 Y'_{62} are the same or different and $Y'_{41}, Y'_{45},$
 $Y'_{48}, Y'_{52}, Y'_{56},$ and Y'_{59} are one or more
 hydrogen, halogen, alkylcarbonyl,
 alkylcarbonylalkyl, alkoxycarbonylalkyl,
 alkoxycarbonylalkylthio, polyhaloalkenylthio,
 thiocyno, propargylthio, hydroxyimino, alkoxyimino,
 trialkylsilyloxy, aryldialkylsilyloxy,
 triarylsilyloxy, formamidino, alkylsulfamido,
 dialkylsulfamido, alkoxysulfonyl,
 polyhaloalkoxysulfonyl, hydroxy, amino,
 aminocarbonyl, alkylaminocarbonyl,
 dialkylaminocarbonyl, aminothiocarbonyl,
 alkylaminothiocarbonyl, dialkylaminothiocarbonyl,
 nitro, cyano, hydroxycarbonyl and derivative salts
 formamido, alkyl, alkoxy, polyhaloalkyl,
 polyhaloalkoxy, alkoxycarbonyl, substituted amino in
 which the permissible substituents are the same or

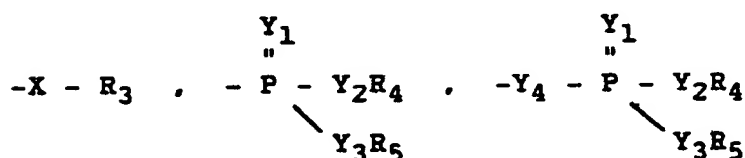
- 631 -

different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,

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alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X. = X. -X = R₃. = X-R₃.



or

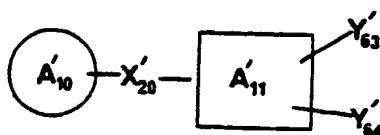


A'₄, A'₅, A'₆, A'₇, A'₈ and A'₉
 are as defined for R₁ in claim 1; and

X'₁₄, X'₁₅, X'₁₆, X'₁₇, X'₁₈ and
 X'₁₉ are the same or different and are O, S, SO,
 SO₂, NH, CH₂, CO, a single covalent bond,
 -CH(CH₃)O-, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-,
 -CH₂CH₂O-, -C≡C-, -CH₂SO-, -CH₂SO₂,
 -OCH₂CH₂O-, -CH(alkyl)- or -CONH-;
 wherein X, R₃, R₄, R₅, Y₁, Y₂, Y₃, and
 Y₄ are as defined in claim 1.

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15. The method of claim 1 in which the compound has the formula



wherein:

A'_{10} is as defined for R_1 in claim 1;

X'_{20} is as defined for X in claim 1;

A'_{11} is a substituted or unsubstituted,

5-membered heterocyclic ring system having at least one nitrogen atom in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl,

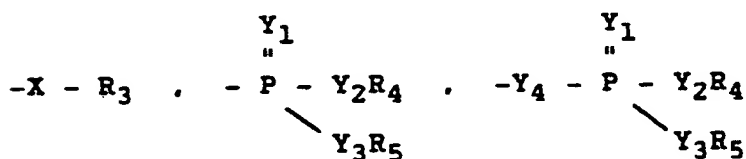
- 634 -

polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio,

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alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



Y'_{63} and Y'_{64} are the same or different
 and are one or more hydrogen, halogen,
 alkylcarbonyl, alkylcarbonylalkyl,
 alkoxycarbonylalkyl, alkoxycarbonylalkylthio,
 polyhaloalkenylthio, thiocyano, propargylthio,
 hydroxyimino, alkoxyimino, trialkylsilyloxy,
 aryldialkylsilyloxy, triarylsilyloxy, formamidino,
 alkylsulfamido, dialkylsulfamido, alkoxysulfonyl,

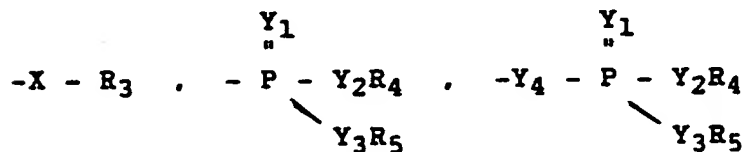
- 636 -

polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio,

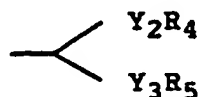
- 637 -

haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
 aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxylalkylphosphinyl,
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxylphosphino, hydroxyamino, alkoxylamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium.

-X, = X, -X = R₃, = X-R₃.



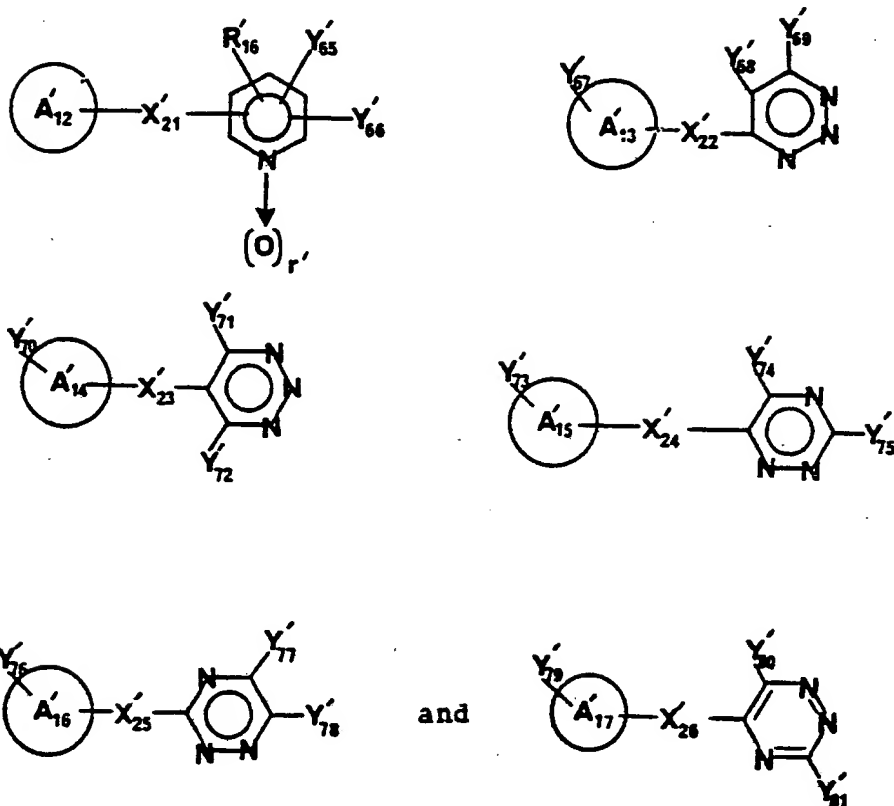
or



wherein X, R₃, R₄, R₅, Y₁, Y₂, Y₃ and Y₄ are as defined in claim 1.

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16. The method of claim 1 in which the compound has the formula selected from



wherein:

$Y'_{65}, Y'_{66}, Y'_{67}, Y'_{68}, Y'_{69},$
 $Y'_{70}, Y'_{71}, Y'_{72}, Y'_{73}, Y'_{74}, Y'_{75},$
 $Y'_{76}, Y'_{77}, Y'_{78}, Y'_{79}, Y'_{80}$ and Y'_{81}
 are the same or different and $Y'_{67}, Y'_{70},$
 Y'_{73}, Y'_{76} and Y'_{79} are one or more hydrogen,
 halogen, alkylcarbonyl, alkylcarbonylalkyl,
 alkoxycarbonylalkyl, alkoxycarbonylalkylthio.

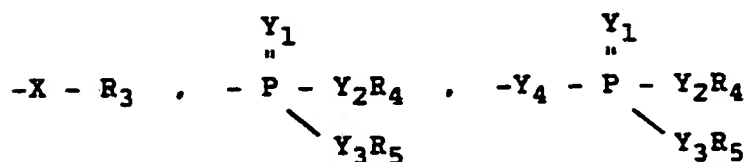
- 639 -

polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,

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aryloxy, aralkoxy, arylthio, aralkylthio,
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxylalkylphosphinyl,
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxylphosphino, hydroxyamino, alkoxylamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium,

-X. = X, -X = R₃. = X-R₃.



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or



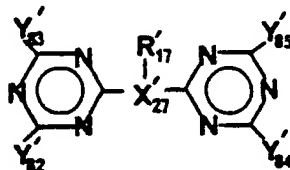
r' is a value of 0 or 1;

A'_{12} , A'_{13} , A'_{14} , A'_{15} , A'_{16} and A'_{17} are as defined for R_1 in claim 1; and

X'_{21} , X'_{22} , X'_{23} , X'_{24} , X'_{25} and X'_{26} are as defined for X in claim 1;

wherein X , R_3 , R_4 , R_5 , Y_1 , Y_2 , Y_3 and Y_4 are as defined in claim 1.

17. The method of claim 1 in which the compound has the formula



wherein:

Y'_{82} , Y'_{83} , Y'_{84} , Y'_{85} and R'_{17} are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothi carbonyl, alkylaminothi carbonyl, dialkylaminothi carbonyl,

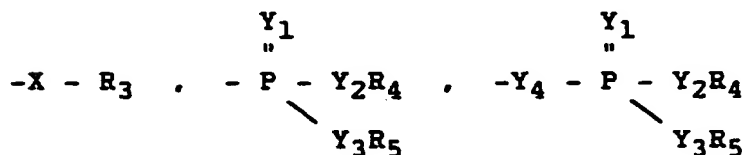
- 642 -

nitro, cyano, hydroxycarbonyl and derivative salts
formamido, alkyl, alkoxy, polyhaloalkyl,
polyhaloalkoxy, alkoxycarbonyl, substituted amino in
which the permissible substituents are the same or
different and are one or two propargyl, alkoxyalkyl,
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or
polyhaloalkenyl; alkylthio, polyhaloalkylthio,
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,
polyhaloalkylsulfonyl, alkylsulfonylamino,
alkylcarbonylamino, polyhaloalkylsulfonylamino,
polyhaloalkylcarbonylamino, trialkylsilyl,
aryldialkylsilyl, triarylsilyl, sulfonic acid and
derivative salts, phosphonic acid and derivative
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,
polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
aroyle, haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl,

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dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



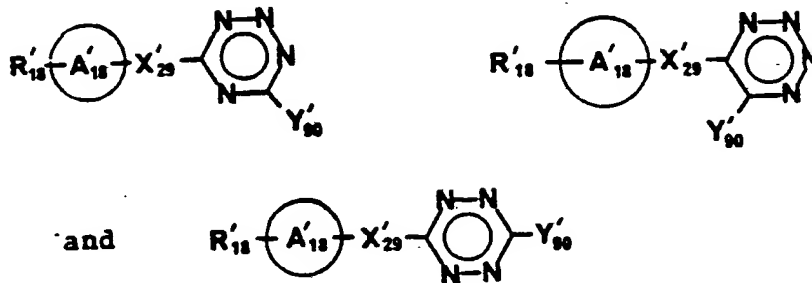
or



X'_{27} is as defined for X in claim 1;
 wherein X, R_3 , R_4 , R_5 , Y_1 , Y_2 , Y_3 and
 Y_4 are as defined in claim 1.

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18. The method of claim 1 in which the compound has the formula selected from



wherein:

R'_{18} and Y'_{90} are the same or different and R'_{18} is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino,

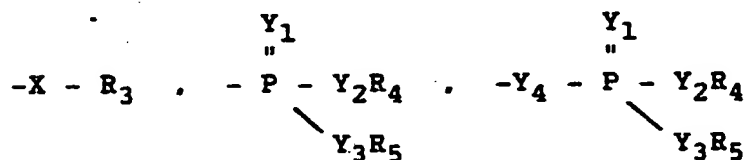
- 645 -

alkylcarbonylamino, polyhaloalkylsulfonylamino,
polyhaloalkylcarbonylamino, trialkylsilyl,
aryldialkylsilyl, triarylsilyl, sulfonic acid and
derivative salts, phosphonic acid and derivative
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,
polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl,
dialkylaminosulfonyl, arylaminosulfonyl,
carboxyalkoxy, carboxyalkylthio,
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
alkenylsulfonyloxy, arylsulfonyloxy,
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
aroylamino, haloacylamino, alkoxycarbonyloxy,
arylsulfonylamino, aminocarbonyloxy, cyanato,
isocyanato, isothiocyano, cycloalkylamino,

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trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X_1 = X$, $-X = R_3$, $= X-R_3$.



or



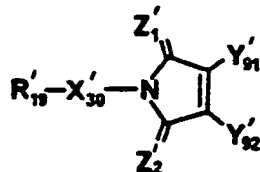
A'_{18} is as defined for R_1 in claim 1;

and

X'_{29} is as defined for X in claim 1;

wherein X , R_3 , R_4 , R_5 , Y_1 , Y_2 , Y_3 and
 Y_4 are as defined in claim 1.

19. The method of claim 1 in which the
 compound has the formula



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wherein:

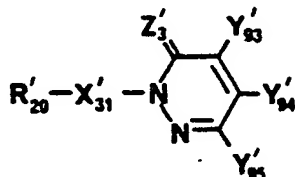
R'_{19} is as defined for R_1 in claim 1;

X'_{30} is as defined for X in claim 1;

Z'_1 and Z'_2 are independently O, S, C_1-C_8 alkylidene, substituted or unsubstituted benzylidene, NH or NR''' wherein R''' is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

Y'_{91} and Y'_{92} are independently halogen, alkyl or alkoxy.

20. The method of claim 1 in which the compound has the formula



wherein:

R'_{20} is as defined for R_1 in claim 1;

X'_{31} is as defined for X in claim 1;

Z'_3 is O, S, C_1-C_8 alkylidene, substituted or unsubstituted benzylidene, NH or NR''' wherein R''' is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

Y'_{93} , Y'_{94} and Y'_{95} are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl.

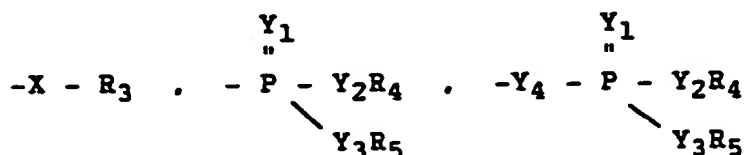
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polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio,

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haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
 aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



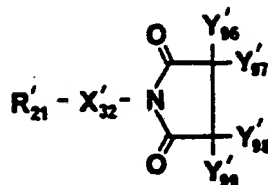
or



wherein $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$ and Y_4 are as defined in claim 1.

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21. The method of claim 1 in which the compound has the formula



wherein:

R'_{21} is as defined for R_1 in claim 1;
 X'_{32} is as defined for X in claim 1; and
 Y'_{96} , Y'_{97} , Y'_{98} and Y'_{99} are the same or different and are hydrogen, halogen, alkyl or alkoxy.

22. The method of claim 1 in which the compound has the formula



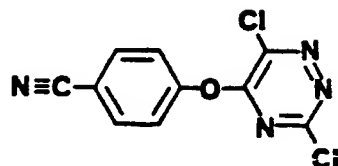
wherein:

R'_{22} is as defined for R_1 in claim 1;
 and

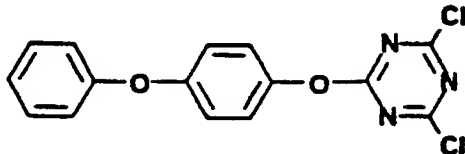
X'_{33} and Z'_{4} are independently hydrogen, halogen, hydroxy, alkyl, alkoxy, alkylcarbonyl or alkoxy carbonyl.

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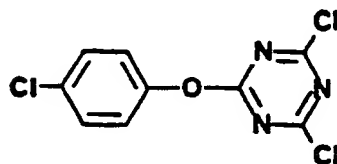
23. The method of claim 1 in which the compound has the formula



24. The method of claim 1 in which the compound has the formula

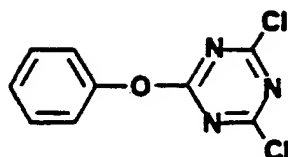


25. The method of claim 1 in which the compound has the formula

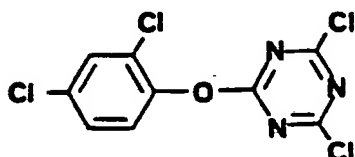


26. The method of claim 1 in which the compound has the formula

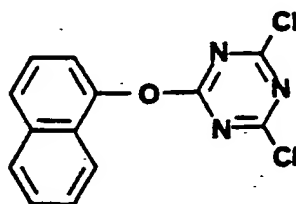
- 652 -



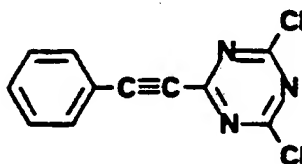
27. The method of claim 1 in which the compound has the formula



28. The method of claim 1 in which the compound has the formula

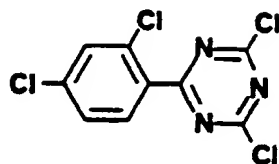


29. The method of claim 1 in which the compound has the formula

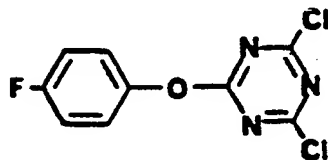


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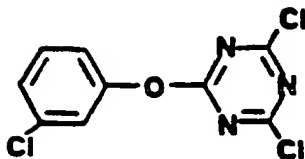
30. The method of claim 1 in which the compound has the formula



31. The method of claim 1 in which the compound has the formula

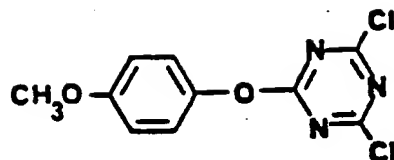


32. The method of claim 1 in which the compound has the formula

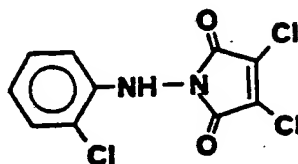


33. The method of claim 1 in which the compound has the formula

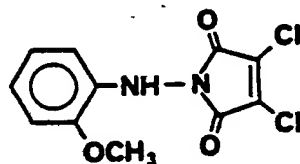
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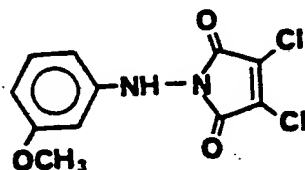
34. The method of claim 1 in which the compound has the formula



35. The method of claim 1 in which the compound has the formula

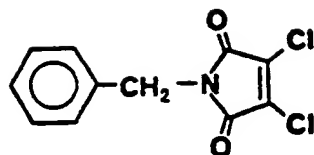


36. The method of claim 1 in which the compound has the formula

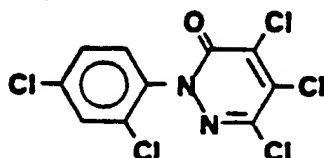


37. The method of claim 1 in which the compound has the formula

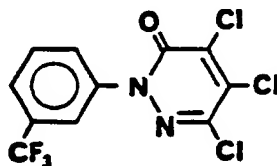
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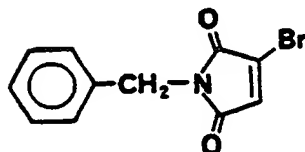
38. The method of claim 1 in which the compound has the formula



39. The method of claim 1 in which the compound has the formula



40. The method of claim 1 in which the compound has the formula



41. A method of reducing moisture loss from plants which comprises applying to the plant surface an effective amount, sufficient to reduce moisture loss from the plant surface without substantially inhibiting plant photosynthetic electron transport, of a compound of claim 105.

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42. The method of claim 1 wherein the compound is applied to the plant surface in an amount sufficient to reduce moisture loss from the plant surface without causing substantial inhibition of plant photosynthetic light reactions.

43. The method of claim 1 wherein the compound is applied to the plant surface at a condition of substantially no plant water stress.

44. The method of claim 1 wherein the compound is applied to the plant surface at a period prior to the plant reproductive growth phase.

45. The method of claim 1 wherein the compound is applied to the plant surface at a period prior to substantial soil moisture loss.

46. The method of claim 1 wherein the compound is applied to the plant surface at a period during the plant reproductive growth phase.

47. The method of claim 1 wherein the compound is applied to the plant surface at a concentration of from about 0.1 to about 100 pounds of compound per acre.

48. The method of claim 1 wherein the compound is applied to the plant surface at a concentration of from about 0.25 to about 15 pounds of compound per acre.

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49. The method of claim 1 wherein the plant is any agronomic or horticultural crop, ornamental or turfgrass.

50. The method of claim 1 wherein the plant is selected from corn, cotton, sweet potatoes, white potatoes, alfalfa, wheat, rye, upland rice, barley, oats, sorghum, dry beans, soy beans, sugar beets, sunflowers, tobacco, tomatoes, canola, deciduous fruit, citrus fruit, tea, coffee, olives, pineapple, cocoa, banana, sugar cane, oil palm, herbaceous bedding plants, woody shrubs, turfgrasses, ornamental plants, evergreens, trees, and flowers.

51. The method of claim 1 wherein the plant is transplanted stock.

52. The method of claim 51 wherein the transplanted stock is selected from tobacco, tomatoes, eggplant, cucumbers, lettuce, strawberries, herbaceous bedding plants, woody shrubs and tree seedlings.

53. A method of increasing crop yield which comprises applying to the crop an effective amount, sufficient to increase crop yield without substantially inhibiting plant photosynthetic electron transport, of a compound having the formula:



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wherein:

R_1 is a substituted or unsubstituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and

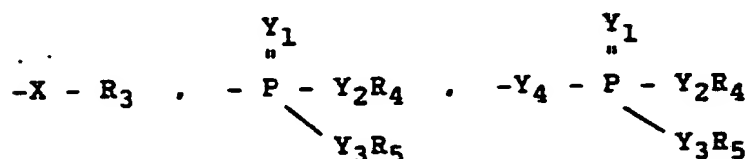
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derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl, alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,

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dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium.

$-X, = X, -X = R_3, = X-R_3,$



or



R_1 is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts

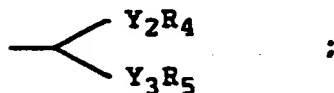
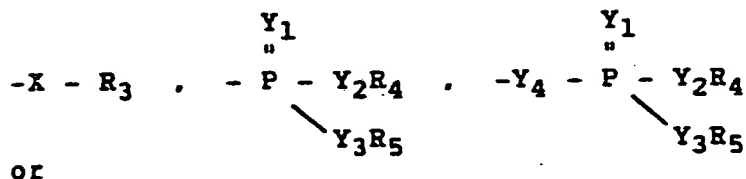
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formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl,

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carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxylalkylphosphinyl,
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxylphosphino, hydroxyamino, alkoxylamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3.$



X is a covalent single bond or double bond,
 a substituted or unsubstituted heteroatom or
 substituted carbon atom, or a substituted or
 unsubstituted, branched or straight chain containing
 two or more carbon atoms or heteroatoms in any
 combination in which the permissible substituents
 are the same or different and are one or more
 hydrogen, halogen, alkylcarbonyl,

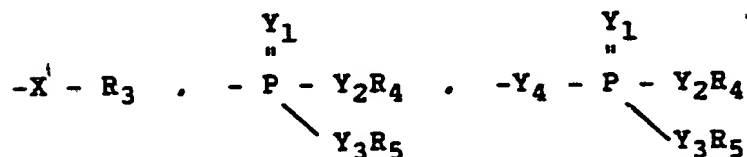
- 663 -

alkylcarbonylalkyl, alkoxycarbonylalkyl,
alkoxycarbonylalkylthio, polyhaloalkenylthio,
thiocyano, propargylthio, hydroxyimino, alkoxyimino,
trialkylsilyloxy, aryldialkylsilyloxy,
triarylsilyloxy, formamidino, alkylsulfamido,
dialkylsulfamido, alkoxysulfonyl,
polyhaloalkoxysulfonyl, hydroxy, amino,
aminocarbonyl, alkylaminocarbonyl,
dialkylaminocarbonyl, aminothiocabonyl,
alkylaminothiocabonyl, dialkylaminothiocabonyl,
nitro, cyano, hydroxycarbonyl and derivative salts
formamido, alkyl, alkoxy, polyhaloalkyl,
polyhaloalkoxy, alkoxycarbonyl, substituted amino in
which the permissible substituents are the same or
different and are one or two propargyl, alkoxyalkyl,
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or
polyhaloalkenyl; alkylthio, polyhaloalkylthio,
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,
polyhaloalkylsulfonyl, alkylsulfonylamino,
alkylcarbonylamino, polyhaloalkylsulfonylamino,
polyhaloalkylcarbonylamino, trialkylsilyl,
aryldialkylsilyl, triarylsilyl, sulfonic acid and
derivative salts, phosphonic acid and derivative
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,
polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group

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condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl,
dialkylaminosulfonyl, arylaminosulfonyl,
carboxyalkoxy, carboxyalkylthio,
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
alkenylsulfonyloxy, arylsulfonyloxy,
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
aroylamino, haloacylamino, alkoxycarbonyloxy,
arylsulfonylamino, aminocarbonyloxy, cyanato,
isocyanato, isothiocyano, cycloalkylamino,
trialkylammonium, arylamino, aryl(alkyl)amino,
aralkylamino, alkoxyalkylphosphinyl,
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
dialkoxyphosphino, hydroxyamino, alkoxyamino,
aryloxyamino, aryloxyimino, oxo, thiono,
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X. -X = R₃, = X-R₃.



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or



R_2 is a substituted or unsubstituted, heterocyclic ring system having at least one nitrogen atom which is selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocabonyl, dialkylaminothiocabonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,

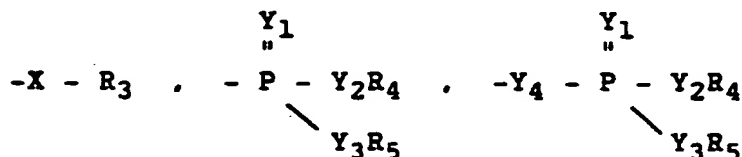
- 666 -

polyhaloalkylsulfonyl, alkylsulfonylamino,
alkylcarbonylamino, polyhaloalkylsulfonylamino,
polyhaloalkylcarbonylamino, trialkylsilyl,
aryldialkylsilyl, triarylsilyl, sulfonic acid and
derivative salts, phosphonic acid and derivative
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,
polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl,
dialkylaminosulfonyl, arylaminosulfonyl,
carboxyalkoxy, carboxyalkylthio,
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
alkenylsulfonyloxy, arylsulfonyloxy,
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
aroylamino, haloacylamino, alkoxycarbonyloxy,
arylsulfonylamino, aminocarbonyloxy, cyanato,

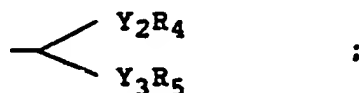
- 667 -

isocyanato, isothiocyano, cycloalkylamino,
trialkylammonium, arylamino, aryl(alkyl)amino,
aralkylamino, alkoxyalkylphosphinyl,
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
dialkoxyphosphino, hydroxyamino, alkoxyamino,
aryloxyamino, aryloxyimino, oxo, thiono,
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



wherein:

R_3 is a substituted or unsubstituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxyalkonylalkyl, alkoxyalkonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy,

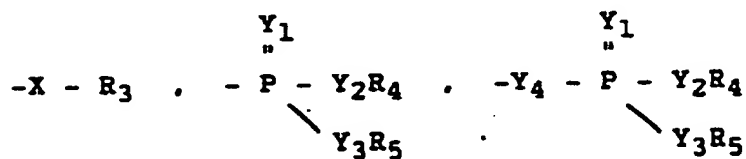
- 668 -

triarylsilyloxy, formamidino, alkylsulfamido,
dialkylsulfamido, alkoxysulfonyl,
polyhaloalkoxysulfonyl, hydroxy, amino,
aminocarbonyl, alkylaminocarbonyl,
dialkylaminocarbonyl, aminothiocabonyl,
alkylaminothiocabonyl, dialkylaminothiocabonyl,
nitro, cyano, hydroxycarbonyl and derivative salts
formamido, alkyl, alkoxy, polyhaloalkyl,
polyhaloalkoxy, alkoxycarbonyl, substituted amino in
which the permissible substituents are the same or
different and are one or two propargyl, alkoxyalkyl,
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or
polyhaloalkenyl; alkylthio, polyhaloalkylthio,
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,
polyhaloalkylsulfonyl, alkylsulfonylamino,
alkylcarbonylamino, polyhaloalkylsulfonylamino,
polyhaloalkylcarbonylamino, trialkylsilyl,
aryldialkylsilyl, triarylsilyl, sulfonic acid and
derivative salts, phosphonic acid and derivative
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,
polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,

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arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl,
dialkylaminosulfonyl, arylaminosulfonyl,
carboxyalkoxy, carboxyalkylthio,
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
alkenylsulfonyloxy, arylsulfonyloxy,
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
aroylamino, haloacylamino, alkoxycarbonyloxy,
arylsulfonylamino, aminocarbonyloxy, cyanato,
isocyanato, isothiocyano, cycloalkylamino,
trialkylammonium, arylamino, aryl(alkyl)amino,
aralkylamino, alkoxyalkylphosphinyl,
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
dialkoxyphosphino, hydroxyamino, alkoxyamino,
aryloxyamino, aryloxyimino, oxo, thiono,
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium.

$-X, = X, -X = R_3, = X-R_3,$



or

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R_3 is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and

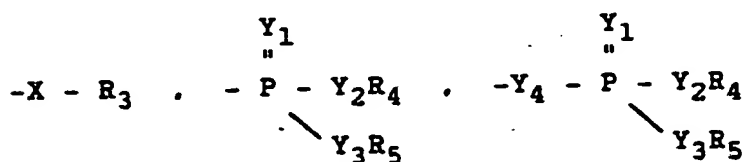
- 671 -

derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl, alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,

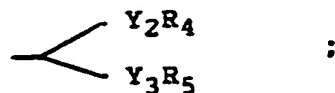
- 672 -

dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



Y_1 and Y_4 are independently oxygen or sulfur;

Y_2 and Y_3 are independently oxygen, sulfur, amino or a covalent bond; and

R_4 and R_5 are independently hydrogen or substituted or unsubstituted alkyl, polyhaloalkyl, phenyl or benzyl in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl,

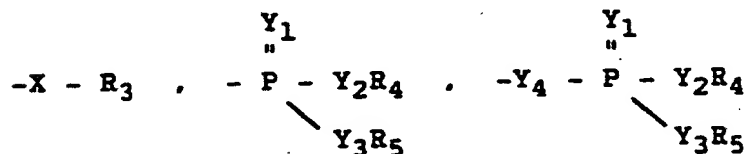
- 673 -

alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,

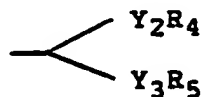
- 674 -

aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxylalkylphosphinyl,
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxylphosphino, hydroxyamino, alkoxylamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R₃, = X-R₃.

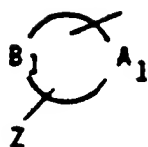


or

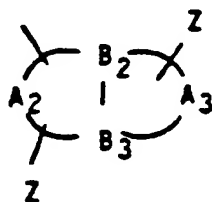


54. The method of claim 53 wherein R₁
 and R₃ are independently a substituted or
 unsubstituted, carbocyclic or heterocyclic ring
 system selected from a monocyclic aromatic or
 nonaromatic ring system having the formula

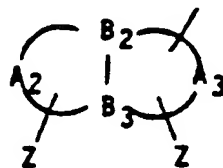
- 675 -



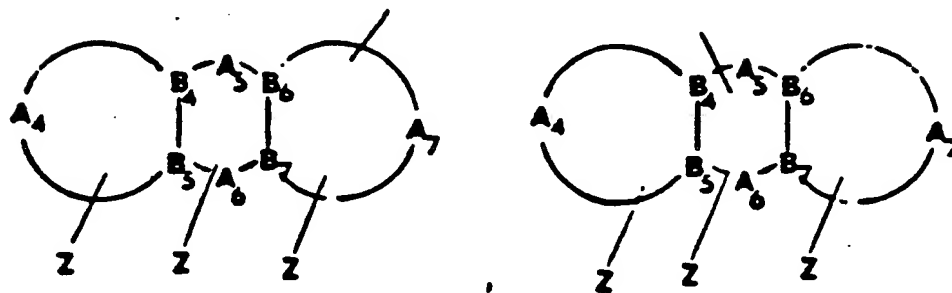
a bicyclic aromatic or nonaromatic ring system
having the formula selected from



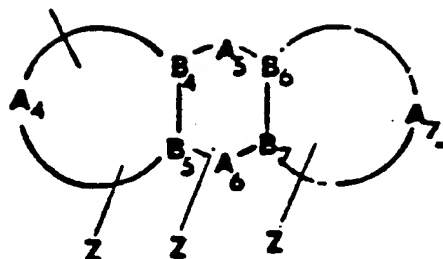
and



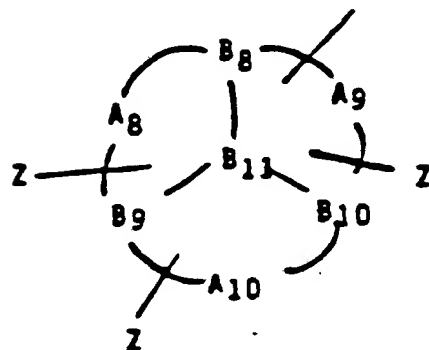
a polycyclic aromatic or nonaromatic ring system
having the formula selected from



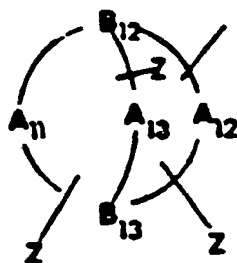
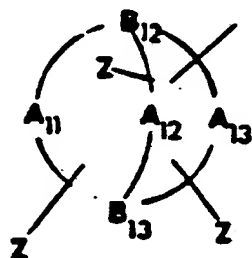
- 676 -



and

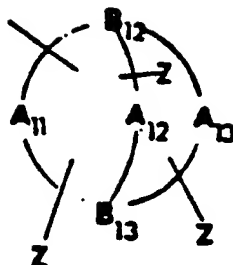


and a bridged ring system which may be saturated or unsaturated having the formula selected from



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and



wherein:

A_1 represents a ring-forming chain of atoms which together with B_1 forms a carbocyclic or heterocyclic ring system containing from 0 to 4 double bonds or from 0 to 2 triple bonds;

B_1 represents a saturated or unsaturated carbon atom;

A_2 and A_3 independently represent a ring-forming chain of atoms which together with B_2 and B_3 form a carbocyclic or heterocyclic ring system;

B_2 and B_3 are independently a saturated or unsaturated carbon atom or a saturated nitrogen atom;

A_4 , A_5 , A_6 and A_7 independently represent a ring-forming chain of atoms which together with B_4 , B_5 , B_6 and B_7 form a carbocyclic or heterocyclic ring system;

B_4 , B_5 , B_6 and B_7 are independently a saturated or unsaturated carbon atom or a saturated nitrogen atom;

A_8 , A_9 and A_{10} independently represent a ring-forming chain of atoms which

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together with B₈, B₉, B₁₀ and B₁₁ form a carbocyclic or heterocyclic ring system;

B₈, B₉ and B₁₀ are independently a saturated or unsaturated carbon atom or a saturated nitrogen atom;

B₁₁ represents a saturated or unsaturated carbon atom, nitrogen atom or phosphorous atom;

A₁₁, A₁₂ and A₁₃ independently represent a ring-forming chain of atoms which together with B₁₂ and B₁₃ form a carbocyclic or heterocyclic ring system;

B₁₂ and B₁₃ are independently a saturated carbon atom or a nitrogen atom; and

Z is the same or different and is one or more of hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio,

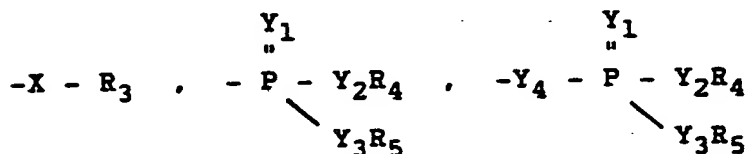
- 679 -

alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy,

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arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$

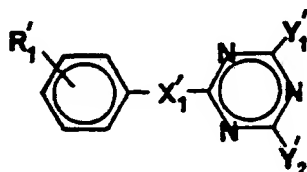


or



wherein $R_3, R_4, R_5, Y_1, Y_2, Y_3, Y_4$ and X are as defined in claim 42.

55. The method of claim 53 in which the compound has the formula



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wherein:

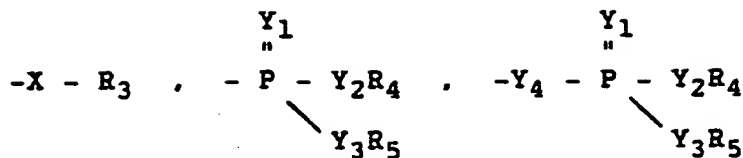
R'_1 is the same or different and is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,

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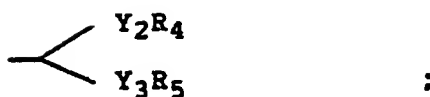
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl,
dialkylaminosulfonyl, arylaminosulfonyl,
carboxyalkoxy, carboxyalkylthio,
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
alkenylsulfonyloxy, arylsulfonyloxy,
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
aroylamino, haloacylamino, alkoxycarbonyloxy,
arylsulfonylamino, aminocarbonyloxy, cyanato,
isocyanato, isothiocyano, cycloalkylamino,
trialkylammonium, arylamino, aryl(alkyl)amino,
aralkylamino, alkoxyalkylphosphinyl,
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
dialkoxyphosphino, hydroxyamino, alkoxyamino,
aryloxyamino, aryloxyimino, oxo, thiono,
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X. -X = R₃, = X-R₃.

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or

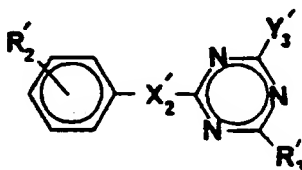


X'_1 is O, S, SO, SO₂, NH, CH₂, CO, a single covalent bond, CH₂O, CH₂S, -CH(CH₃)O, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -CH₂CH₂-, -C≡C-, -CH₂SO-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)- or -CONH-; and

Y'_1 and Y'_2 are independently halogen, alkyl or alkoxy;

wherein X, R₃, R₄, R₅, Y₁, Y₂, Y₃ and Y₄ are as defined in claim 42.

56. The method of claim 53 in which the compound has the formula



wherein:

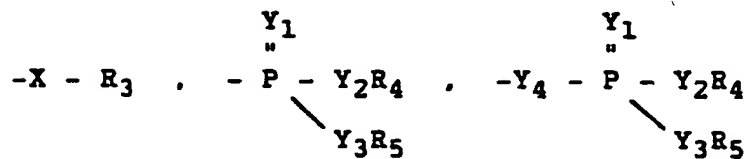
R'₂ and R'₃ are the same or different and R'₂ is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino.

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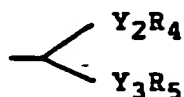
alkylsulfamido, dialkylsulfamido, trialkylsilyloxy,
polyhaloalkoxysulfonyl, hydroxy, amino,
aminocarbonyl, alkylaminocarbonyl,
dialkylaminocarbonyl, aminothiocarbonyl,
alkylaminothiocarbonyl, dialkylaminothiocarbonyl,
nitro, cyano, hydroxycarbonyl and derivative salts
formamido, alkyl, alkoxy, polyhaloalkyl,
polyhaloalkoxy, alkoxycarbonyl, substituted amino in
which the permissible substituents are the same or
different and are one or two propargyl, alkoxyalkyl,
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or
polyhaloalkenyl; alkylthio, polyhaloalkylthio,
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,
polyhaloalkylsulfonyl, alkylsulfonylamino,
alkylcarbonylamino, polyhaloalkylsulfonylamino,
polyhaloalkylcarbonylamino, trialkylsilyl,
aryldialkylsilyl, triarylsilyl, sulfonic acid and
derivative salts, phosphonic acid and derivative
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,
polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl.

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haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
 aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyposphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,
 $-X, = X, -X = R_3, = X-R_3,$



or



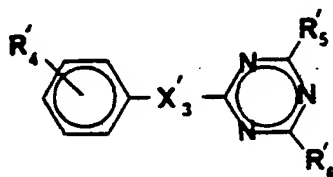
- 686 -

X'_2 is O, S, SO, SO_2 , NH, CH_2 , CO, a single covalent bond, $-CH(CH_3)O-$, $-CH(CN)O-$, $-CH=NO-$, $-C(CH_3)=NO-$, $-CH_2CH_2O-$, $-C\equiv C-$, $-CH_2SO-$ or $-CH_2SO_2-$; and

Y'_3 is halogen;

wherein X, R_3 , R_4 , R_5 , Y_1 , Y_2 , Y_3 and Y_4 are as defined in claim 42.

57. The method of claim 53 in which the compound has the formula .



wherein:

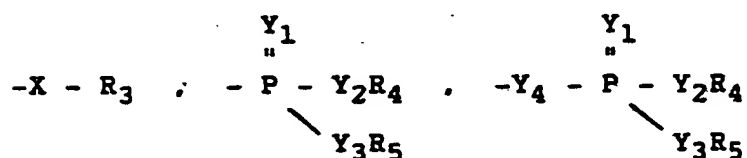
R'_4 , R'_5 and R'_6 are the same or different and R'_4 is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl,

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alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,

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aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxylalkylphosphinyl,
 alkoxylalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxylphosphino, hydroxyamino, alkoxylamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxylalkoxy,
 alkoxylalkenyl, cyanoalkoxy, dialkylsulfonium,
 $-X$, $=X$, $-X = R_3$, $=X-R_3$.



or

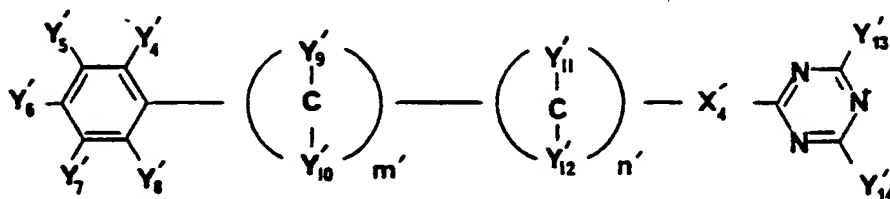


X'_3 is O, S, SO, SO₂, NH, CH₂, CO, a
 single covalent bond, -CH(CH₃)O-, -CH(CN)O-,
 -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -C≡C-,
 -CH₂SO-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)-
 or -CONH-;

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wherein X, R₃, R₄, R₅, Y₁, Y₂, Y₃ and Y₄ are as defined in claim 42.

58. The method of claim 53 in which the compound has the formula



wherein:

Y'₄, Y'₅, Y'₆, Y'₇ and Y'₈ are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothi carbonyl, alkylaminothi carbonyl, dialkylaminothi carbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl.

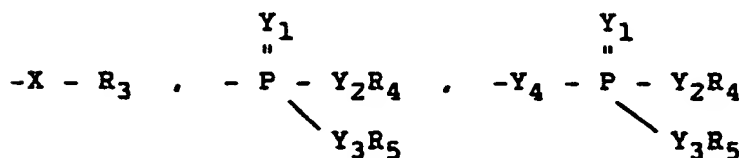
- 690 -

polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio,

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alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



Y'_9, Y'_{10}, Y'_{11} and Y'_{12} are the same or different and are hydrogen, halogen, alkyl, polyhaloalkyl, cyano or aryl;

m' and n' are the same or different and are a value of from 0 to 5;

X'_4 is O, S, SO, SO₂, NH, CH₂, CO, a single covalent bond, -CH(CH₃)O-, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -C≡C-,

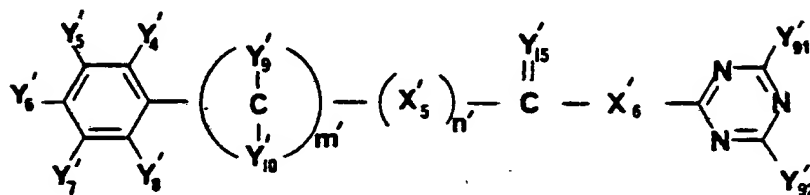
- 692 -

$-\text{CH}_2\text{SO}-$, $-\text{CH}_2\text{SO}_2-$, $-\text{OCH}_2\text{CH}_2\text{O}-$, $-\text{CH}(\text{alkyl})-$
or $-\text{CONH}-$; and

Y'_{13} and Y'_{14} are the same or different
and are halogen, alkyl or alkoxy;

wherein X , R_3 , R_4 , R_5 , Y_1 , Y_2 , Y_3 and
 Y_4 are as defined in claim 42.

59. The method of claim 53 in which the
compound has the formula



wherein:

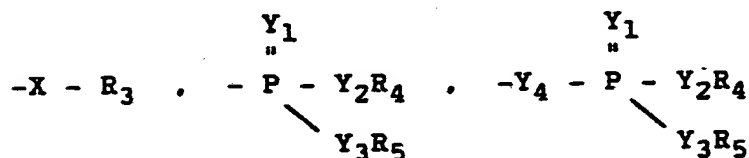
Y'_4 , Y'_5 , Y'_6 , Y'_7 and Y'_8 are
the same or different and are hydrogen, halogen,
alkylcarbonyl, alkylcarbonylalkyl,
alkoxycarbonylalkyl, alkoxycarbonylalkylthio,
polyhaloalkenylthio, thiocyno, propargylthio,
hydroxyimino, alkoxyimino, trialkylsilyloxy,
aryldialkylsilyloxy, triarylsilyloxy, formamidino,
alkylsulfamido, dialkylsulfamido, alkoxysulfonyl,
polyhaloalkoxysulfonyl, hydroxy, amino,
aminocarbonyl, alkylaminocarbonyl,
dialkylaminocarbonyl, aminothiocarbonyl,
alkylaminothiocarbonyl, dialkylaminothiocarbonyl.

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nitro, cyano, hydroxycarbonyl and derivative salts
formamido, alkyl, alkoxy, polyhaloalkyl,
polyhaloalkoxy, alkoxycarbonyl, substituted amino in
which the permissible substituents are the same or
different and are one or two propargyl, alkoxyalkyl,
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or
polyhaloalkenyl; alkylthio, polyhaloalkylthio,
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,
polyhaloalkylsulfonyl, alkylsulfonylamino,
alkylcarbonylamino, polyhaloalkylsulfonylamino,
polyhaloalkylcarbonylamino, trialkylsilyl,
aryldialkylsilyl, triarylsilyl, sulfonic acid and
derivative salts, phosphonic acid and derivative
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,
polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl.

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dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,
 $-X, = X, -X = R_3, = X-R_3,$



or



Y'_9 and Y'_{10} are the same or different
 and are hydrogen, halogen, alkyl, polyhaloalkyl,
 cyano or aryl;

m' and n' are the same or different and are
 a value of from 0 to 5;

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X'_5 is the same or different and is O, S, SO, SO₂, NH, CH₂, CO, a single covalent bond, -CH(CH₃)O-, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -C≡C-, -CH₂SO-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)- or -CONH-;

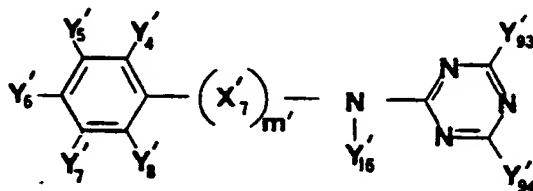
Y'_{15} is O or S;

Y'_{91} and Y'_{92} are independently halogen; and

X'_6 is O or S;

wherein X, R₃, R₄, R₅, Y₁, Y₂, Y₃ and Y₄ are as defined in claim 42.

60. The method of claim 53 in which the compound has the formula



wherein:

Y'_4 , Y'_5 , Y'_6 , Y'_7 and Y'_8 are the same as different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino,

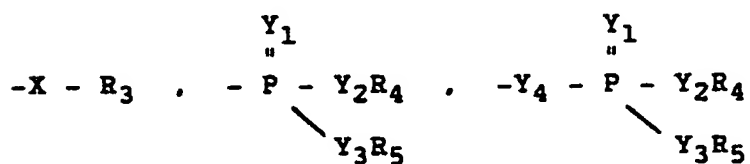
- 696 -

alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl.

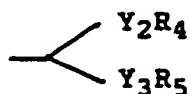
- 697 -

haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
 aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3.$



or



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X'_7 is the same or different and is O, S, SO, SO_2 , NH, CH_2 , CO, a single covalent bond, $-CH(CH_3)O-$, $-CH(CN)O-$, $-CH=NO-$, $-C(CH_3)=NO-$, $-CH_2CH_2O-$, $-C\equiv C-$, $-CH_2SO-$, $-CH_2SO_2-$, $-OCH_2CH_2O-$, $-CH(alkyl)-$ or $-CONH-$;

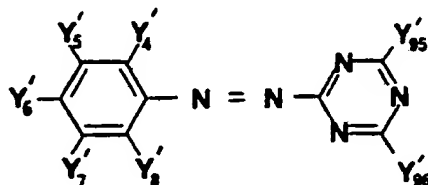
m' is a value of from 0 to 5;

Y'_{93} and Y'_{94} are independently halogen;

Y'_{16} is hydrogen, alkyl, alkylcarbonyl, alkylsulfonyl, or polyhaloalkylsulfonyl;

wherein X, R_3 , R_4 , R_5 , Y_1 , Y_2 , Y_3 and Y_4 are as defined in claim 42.

61. The method of claim 53 in which the compound has the formula



wherein:

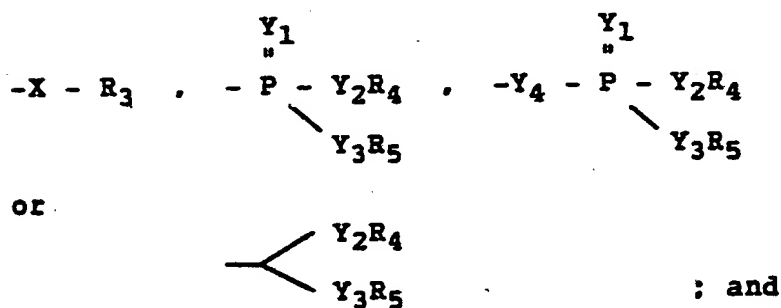
Y'_4 , Y'_5 , Y'_6 , Y'_7 and Y'_8 are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl,

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polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio,

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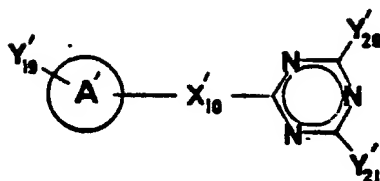
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
 aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,
 $-X$, $=X$, $-X = R_3$, $=X-R_3$.



Y'_{95} and Y'_{96} are independently halogen;
 wherein X , R_3 , R_4 , R_5 , Y_1 , Y_2 , Y_3 and
 Y_4 are as defined in claim 42.

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62. The method of claim 53 in which the compound has the formula



wherein:

Y'_{19} and Y'_{21} are the same or different and Y'_{19} is one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothi carbonyl, alkylaminothi carbonyl, dialkylaminothi carbonyl, nitro, cyano, hydroxycarbonyl and derivative salts formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxy carbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl,

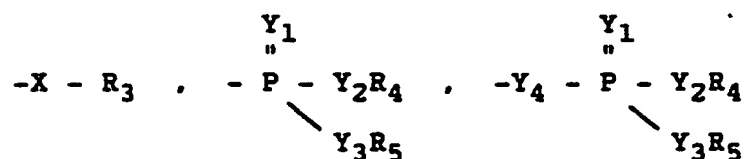
- 702 -

aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl.

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alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
dialkoxyposphino, hydroxyamino, alkoxyamino,
aryloxyamino, aryloxyimino, oxo, thiono,
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$

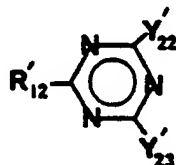


or



A' is as defined for R_1 in claim 42;
 X'_{10} is as defined for X in claim 42; and
 Y'_{20} is halogen, cyano, alkyl, alkoxy,
polyhaloalkyl, polyhaloalkoxy, or
polyhaloalkylsulfonyloxy;
wherein X, R_3 , R_4 , R_5 , Y_1 , Y_2 , Y_3 and
 Y_4 are as defined in claim 42.

63. The method of claim 53 in which the
compound has the formula



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wherein:

R'₁₂ is as defined for R₁ in claim 42;

Y'₂₂ is halogen, cyano, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, or polyhaloalkylsulfonyloxy; and

Y'₂₃ is hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocabonyl, dialkylaminothiocabonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy,

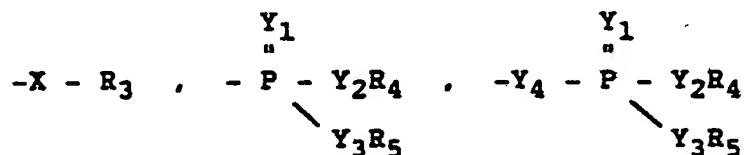
- 705 -

dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxy carbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl, alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl, dialkoxyphosphino, hydroxyamino, alkoxyamino, aryloxyamino, aryloxyimino, oxo, thiono.

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alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$

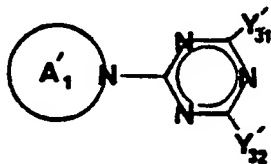


or



wherein $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$ and Y_4 are as defined in claim 42.

64. The method of claim 53 in which the compound has the formula



wherein:

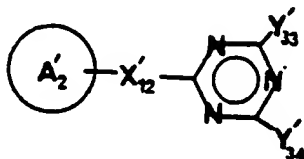
A'_1 is as defined for R_2 in claim 42;

and

Y'_{31} and Y'_{32} are the same or different and are halogen, alkyl or alkoxy.

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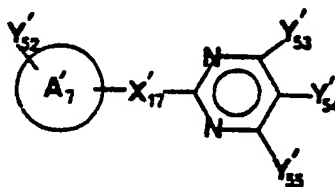
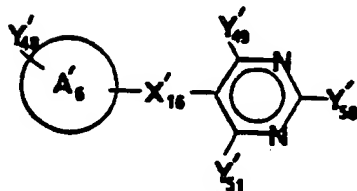
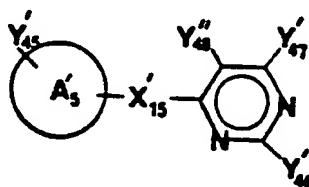
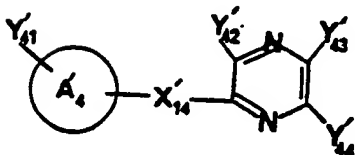
65. The method of claim 53 in which the compound has the formula



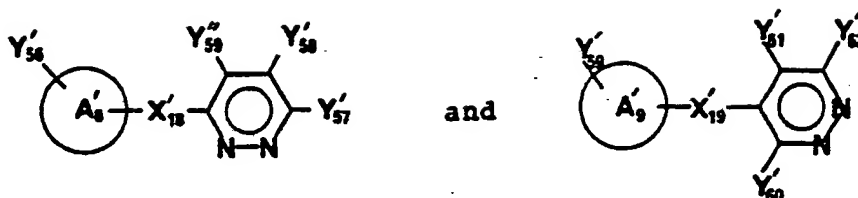
wherein:

A'_2 is as defined for R_1 in claim 42;
 X'_{12} is as defined for X in claim 42; and
 Y'_{33} and Y'_{34} are the same or different
 and are halogen, alkyl or alkoxy.

66. The method of claim 53 in which the compound has the formula selected from



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wherein:

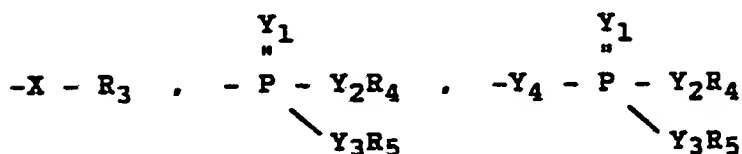
Y' 41, Y' 42, Y' 43, Y' 44, Y' 45,
 Y' 46, Y' 47, Y' 48, Y' 49, Y' 50, Y' 51,
 Y' 48, Y' 52, Y' 53, Y' 54, Y' 55, Y' 56,
 Y' 57, Y' 59, Y' 58, Y' 59, Y' 60, Y' 61, and
 Y' 62 are the same or different and Y' 41, Y' 45,
 Y' 48, Y' 52, Y' 56, and Y' 59 are one or more
 hydrogen, halogen, alkylcarbonyl,
 alkylcarbonylalkyl, alkoxy carbonylalkyl,
 alkoxy carbonylalkylthio, polyhaloalkenylthio,
 thiocyno, propargylthio, hydroxyimino, alkoxyimino,
 trialkylsilyloxy, aryldialkylsilyloxy,
 triarylsilyloxy, formamidino, alkylsulfamido,
 dialkylsulfamido, alkoxy sulfonyl,
 polyhaloalkoxy sulfonyl, hydroxy, amino,
 aminocarbonyl, alkylaminocarbonyl,
 dialkylaminocarbonyl, aminothiocarbonyl,
 alkylaminothiocarbonyl, dialkylaminothiocarbonyl,
 nitro, cyano, hydroxycarbonyl and derivative salts,
 formamido, alkyl, alkoxy, polyhaloalkyl,
 polyhaloalkoxy, alkoxy carbonyl, substituted amino in
 which the permissible substituents are the same or
 different and are one or two propargyl, alkoxyalkyl,
 alkylthioalkyl, alkyl, alkenyl, haloalkenyl or
 polyhaloalkenyl; alkylthio, polyhaloalkylthio,
 alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,
 polyhaloalkylsulfonyl, alkylsulfonylamino,
 alkylcarbonylamino, polyhaloalkylsulfonylamino,
 polyhaloalkylcarbonylamino, trialkylsilyl,

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aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl,

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alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
dialkoxyphosphino, hydroxyamino, alkoxyamino,
aryloxyamino, aryloxyimino, oxo, thiono,
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$$-X_1 = X_1, \quad -X = R_3, \quad = X - R_3.$$


01



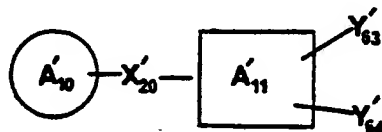
A'4, A'5, A'6, A'7, A'8 and A'9
are as defined for R₁ in claim 42; and

X' 14' X' 15' X' 16' X' 17' X' 18 and
X' 19 are the same or different and are O, S, SO,
SO₂, NH, CH₂, CO, a single covalent bond.

$$-\overset{2}{\text{CH}}(\text{CH}_3)\text{O}-, -\overset{2}{\text{CH}}(\text{CN})\text{O}-, -\text{CH}=\text{NO}-, -\text{C}(\text{CH}_3)=\text{NO}-,$$
$$-\text{CH}_2\overset{\text{O}}{\underset{\text{O}}{\text{CH}_2\text{CH}_2}}\text{O}-, -\text{C}\equiv\text{C}-, -\text{CH}_2\text{SO}-, -\text{CH}_2\text{SO}_2-$$
$$-\text{OCH}_2\text{CH}_2\text{O}-, -\text{CH}(\text{alkyl})- \text{ or } -\text{CONH}-;$$

wherein X , R_3 , R_4 , R_5 , Y_1 , Y_2 , Y_3 , and Y_4 are as defined in claim 42.

67. The method of claim 53 in which the compound has the formula



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wherein:

A'₁₀ is as defined for R₁ in claim 42;

X'₂₀ is as defined for X in claim 42;

A'₁₁ is a substituted or unsubstituted, 5-membered heterocyclic ring system having at least one nitrogen atom in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy,

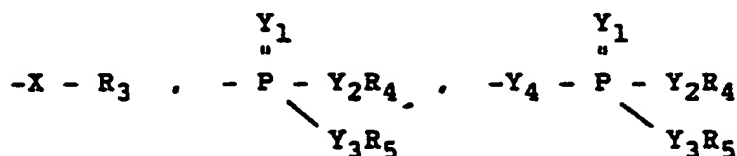
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dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,
polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl,
dialkylaminosulfonyl, arylaminosulfonyl,
carboxyalkoxy, carboxyalkylthio,
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
alkenylsulfonyloxy, arylsulfonyloxy,
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
aroylamino, haloacylamino, alkoxycarbonyloxy,
arylsulfonylamino, aminocarbonyloxy, cyanato,
isocyanato, isothiocyano, cycloalkylamino,
trialkylammonium, arylamino, aryl(alkyl)amino,
aralkylamino, alkoxyalkylphosphinyl,
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
dialkoxyphosphino, hydroxyamino, alkoxyamino,
aryloxyamino, aryloxyimino, oxo, thiono.

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alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



Y'_{63} and Y'_{64} are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxy carbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,

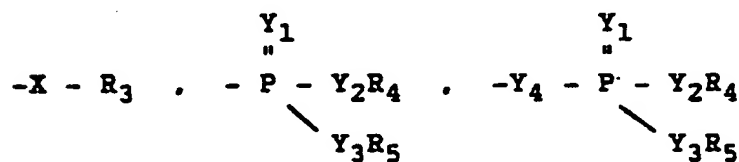
- 714 -

polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato,

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isocyanato, isothiocyano, cycloalkylamino,
trialkylammonium, arylamino, aryl(alkyl)amino,
aralkylamino, alkoxyalkylphosphinyl,
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
dialkoxyphosphino, hydroxyamino, alkoxyamino,
aryloxyamino, aryloxyimino, oxo, thiono,
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$

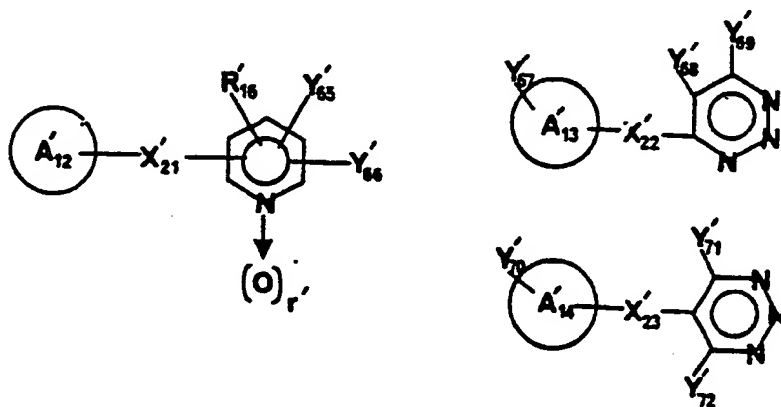


or

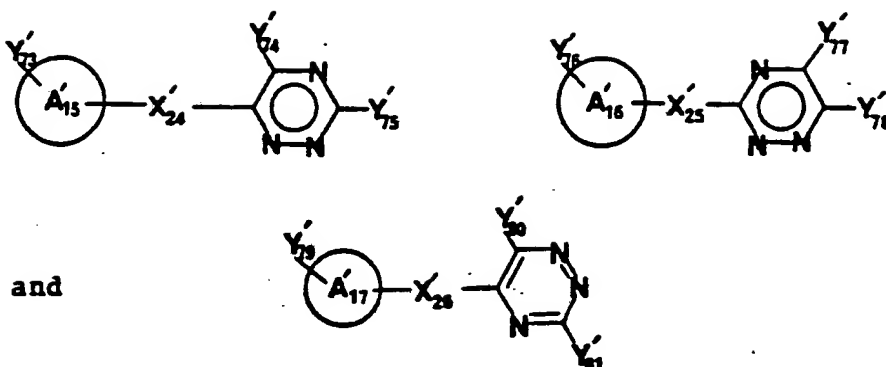


wherein $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$ and Y_4 are as defined in claim 42.

68. The method of claim 53 in which the compound has the formula selected from



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wherein:

Y'⁶⁵, Y'⁶⁶, Y'⁶⁷, Y'⁶⁸, Y'⁶⁹,
 Y'⁷⁰, Y'⁷¹, Y'⁷², Y'⁷³, Y'⁷⁴, Y'⁷⁵,
 Y'⁷⁶, Y'⁷⁷, Y'⁷⁸, Y'⁷⁹, Y'⁸⁰ and Y'⁸¹
 are the same or different and Y'⁶⁷, Y'⁷⁰,
 Y'⁷³, Y'⁷⁶ and Y'⁷⁹ are one or more hydrogen,
 halogen, alkylcarbonyl, alkylcarbonylalkyl,
 alkoxy carbonylalkyl, alkoxy carbonylalkylthio,
 polyhaloalkenylthio, thiocyno, propargylthio,
 hydroxyimino, alkoxyimino, trialkylsilyloxy,
 aryldialkylsilyloxy, triarylsilyloxy, formamidino,
 alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl,
 polyhaloalkoxy sulfonyl, hydroxy, amino,
 aminocarbonyl, alkylaminocarbonyl,
 dialkylaminocarbonyl, aminothi carbonyl,
 alkylaminothi carbonyl, dialkylaminothi carbonyl,
 nitro, cyano, hydroxycarbonyl and derivative salts,
 formamido, alkyl, alkoxy, polyhaloalkyl,
 polyhaloalkoxy, alkoxy carbonyl, substituted amino in
 which the permissible substituents are the same or
 different and are one or two propargyl, alkoxyalkyl,
 alkylthioalkyl, alkyl, alkenyl, haloalkenyl or
 polyhaloalkenyl; alkylthio, polyhaloalkylthio,
 alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,
 polyhaloalkylsulfonyl, alkylsulfonylamino,

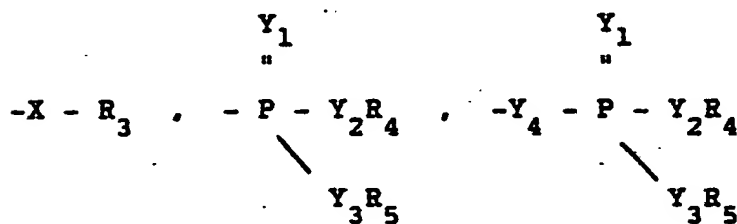
- 717 -

alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino,

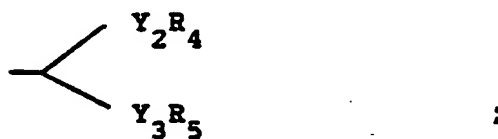
- 718 -

trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$



or



r' is a value of 0 or 1;

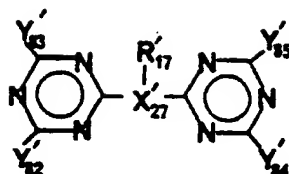
$A'_{12}, A'_{13}, A'_{14}, A'_{15}, A'_{16}$ and
 A'_{17} are as defined for R_1 in claim 42; and

$X'_{21}, X'_{22}, X'_{23}, X'_{24}, X'_{25}$ and
 X'_{26} are as defined for X in claim 42;

wherein $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$ and
 Y_4 are as defined in claim 42.

69. The method of claim 53 in which the
 compound has the formula

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wherein:

Y'82, Y'83, Y'84, Y'85 and R'17 are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy carbonylalkyl, alkoxy carbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy sulfonyl, polyhaloalkoxy sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothi carbonyl, alkylaminothi carbonyl, dialkylaminothi carbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxy carbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and

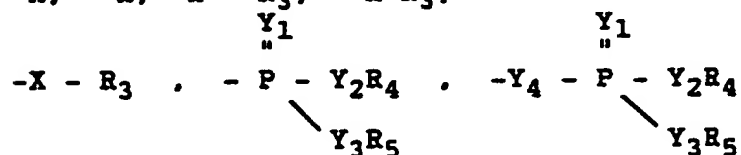
- 720 -

derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl, alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,

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dialkoxyposphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$

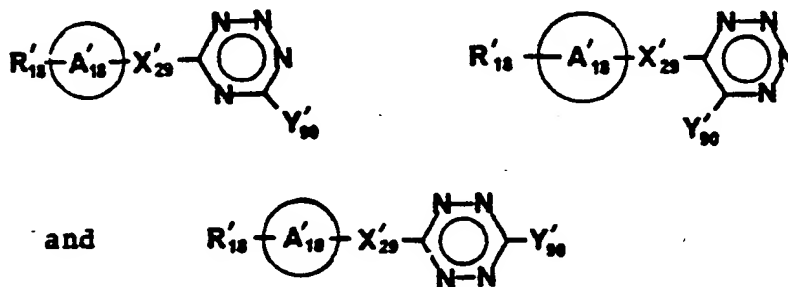


or



X'_{27} is as defined for X in claim 42;
 wherein X, R_3 , R_4 , R_5 , Y_1 , Y_2 , Y_3 and
 Y_4 are as defined in claim 42.

70. The method of claim 53 in which the
 compound has the formula selected from



wherein:

R'_{18} and Y'_{90} are the same or different
 and R'_{18} is one or more hydrogen, halogen,
 alkylcarbonyl, alkylcarbonylalkyl,
 alkoxy carbonylalkyl, alkoxy carbonylalkylthio.

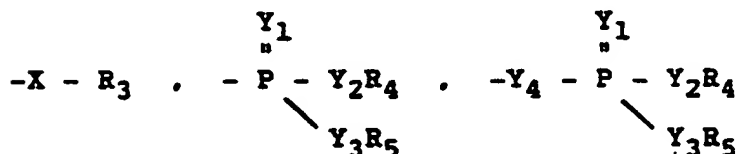
- 722 -

polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocabonyl, dialkylaminothiocabonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,

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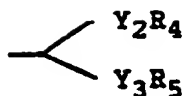
aryloxy, aralkoxy, arylthio, aralkylthio,
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X. = X, -X = R₃, = X-R₃,



or

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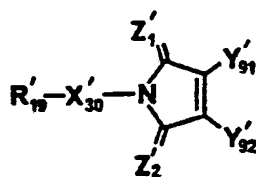
A'_{18} is as defined for R_1 in claim 42;

and

X'_{29} is as defined for X in claim 42;

wherein X , R_3 , R_4 , R_5 , Y_1 , Y_2 , Y_3 and Y_4 are as defined in claim 42.

71. The method of claim 53 in which the compound has the formula



wherein:

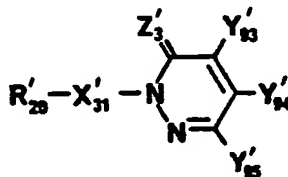
R'_{19} is as defined for R_1 in claim 1;

X'_{30} is as defined for X in claim 1;

Z'_1 and Z'_2 are independently O, S, C_1-C_8 alkylidene, substituted or unsubstituted benzylidene, NH or NR''' wherein R''' is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

Y'_{91} and Y'_{92} are independently halogen, alkyl or alkoxy.

72. The method of claim 53 in which the compound has the formula



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wherein:

R'_{20} is as defined for R_1 in claim 1;

X'_{31} is as defined for X in claim 1;

Z'_3 is O, S, C_1-C_8 alkylidene,

substituted or unsubstituted benzyldiene, NH or NR''' wherein R''' is alyl, aryl, aralkyl, alkenyl or alkynyl; and

Y'_{93} , Y'_{94} and Y'_{95} are the same or different and are hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxy-sulfonyl, polyhaloalkoxy-sulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative

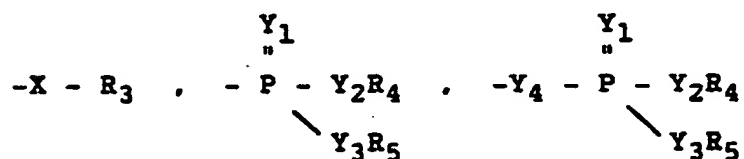
- 726 -

salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, aroylamino, haloacylamino, alkoxycarbonyloxy, arylsulfonylamino, aminocarbonyloxy, cyanato, isocyanato, isothiocyano, cycloalkylamino, trialkylammonium, arylamino, aryl(alkyl)amino, aralkylamino, alkoxyalkylphosphinyl, alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,

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dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

$-X, = X, -X = R_3, = X-R_3,$

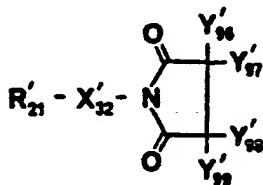


or



wherein $X, R_3, R_4, R_5, Y_1, Y_2, Y_3$ and Y_4 are as defined in claim 1.

73. The method of claim 53 in which the compound has the formula



wherein:

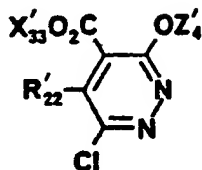
R'_{21} is as defined for R_1 in claim 1;

X'_{32} is as defined for X in claim 1; and

$Y'_{96}, Y'_{97}, Y'_{98}$ and Y'_{99} are the same or different and are hydrogen, halogen, alkyl or alkoxy.

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74. The method of claim 53 in which the compound has the formula



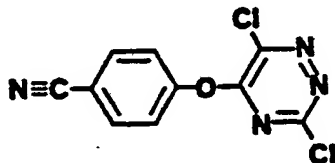
wherein:

R'22 is as defined for R1 in claim 1;

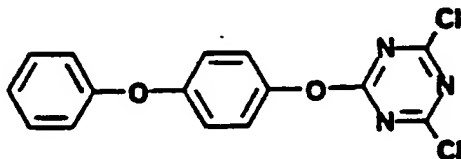
and

X'33 and Z'4 are independently hydrogen, halogen, hydroxy, alkyl, alkoxy, alkylcarbonyl or alkoxy carbonyl.

75. The method of claim 53 in which the compound has the formula

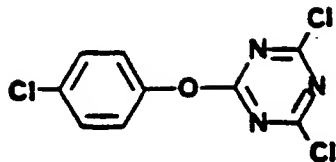


76. The method of claim 53 in which the compound has the formula

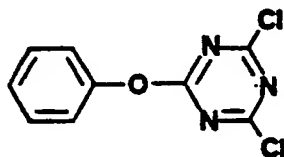


- 729 -

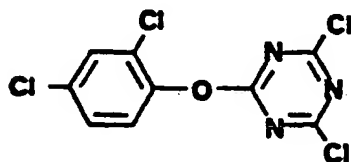
77. The method of claim 53 in which the compound has the formula



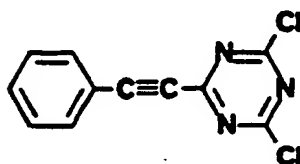
78. The method of claim 53 in which the compound has the formula



79. The method of claim 53 in which the compound has the formula

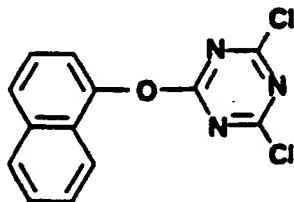


80. The method of claim 53 in which the compound has the formula

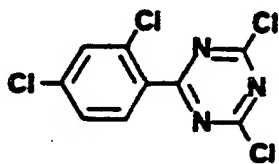


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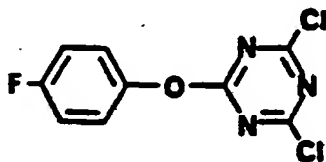
81. The method of claim 53 in which the compound has the formula



82. The method of claim 53 in which the compound has the formula

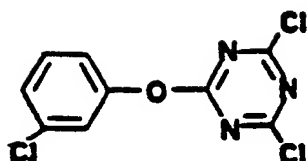


83. The method of claim 53 in which the compound has the formula

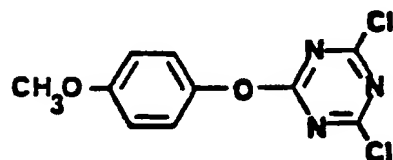


84. The method of claim 53 in which the compound has the formula

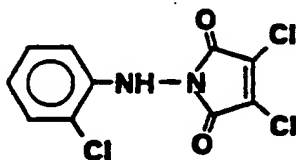
- 731 -



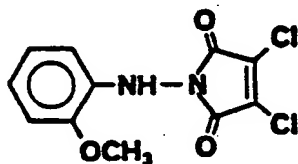
85. The method of claim 53 in which the compound has the formula



86. The method of claim 53 in which the compound has the formula

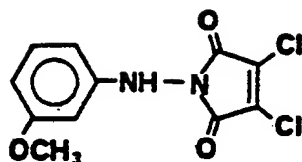


87. The method of claim 53 in which the compound has the formula

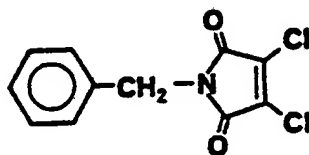


88. The method of claim 53 in which the compound has the formula

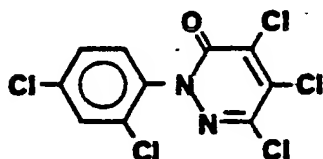
- 732 -



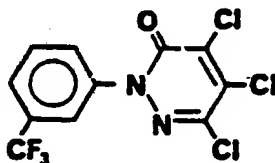
89. The method of claim 53 in which the compound has the formula



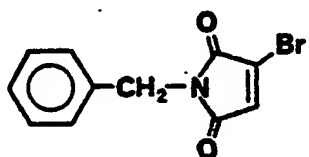
90. The method of claim 53 in which the compound has the formula



91. The method of claim 53 in which the compound has the formula



92. The method of claim 53 in which the compound has the formula



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93. A method of increasing crop yield which comprises applying to the crop an effective amount, sufficient to increase crop yield without substantially inhibiting plant photosynthetic electron transport, of a compound of claim 105.

94. The method of claim 53 wherein the compound is applied to the crop in an amount sufficient to increase crop yield without causing substantial inhibition of plant photosynthetic light reactions.

95. The method of claim 53 wherein the compound is applied to the crop at a condition of substantially no plant water stress.

96. The method of claim 53 wherein the compound is applied to the crop at a period prior to the plant reproductive growth phase.

97. The method of claim 53 wherein the compound is applied to the crop at a period prior to substantial soil moisture loss.

98. The method of claim 53 wherein the compound is applied to the crop at a period during the plant reproductive growth phase.

99. The method of claim 53 wherein the compound is applied to the crop at a concentration of from about 0.1 to about 100 pounds of compound per acre.

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100. The method of claim 53 wherein the compound is applied to the crop at a concentration of from about 0.25 to about 15 pounds of compound per acre.

101. The method of claim 53 wherein the crop is any agronomic or horticultural crop.

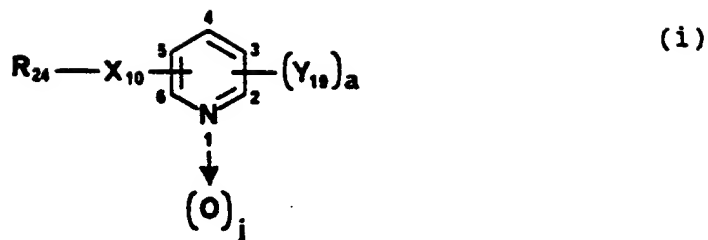
102. The method of claim 53 wherein the crop is selected from corn, cotton, sweet potatoes, white potatoes, alfalfa, wheat, rye, upland rice, barley, oats, sorghum, dry beans, soybeans, sugar beets, sunflowers, tobacco, tomatoes, canola, deciduous fruit, citrus fruit, tea, coffee, olives, pineapple, cocoa, banana, sugar cane and oil palm.

103. The method of claim 53 wherein the crop is transplanted stock.

104. The method of claim 103 wherein the transplanted stock is selected from tobacco, tomatoes, eggplant, cucumbers, lettuce, strawberries, herbaceous bedding plants, woody shrubs and tree seedlings.

105. A compound having the formula selected from the following:

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wherein:

R_{24} represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

X_{10} represents O, S, SO, SO₂, NH, -CH₂O-, -CH₂S-, -CH(CH₃)O-, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -CH₂CH₂-, -C≡C-, -CH₂SO-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)- or -CONH-;

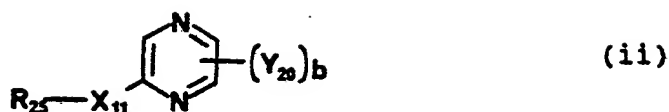
j is a value of 0 or 1;

a is a value of from 2 to 4 inclusive; and

Y_{19} is the same or different and represents halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl provided that (i) at least two ring position pairs selected from 2 and 4, 2 and 6, 2 and 3, and 3 and 4 are substituted with the same or different halogen;

(ii) when ring positions 2,4 and 6 are substituted with chlorine and j is a value of 0 and X_{10} is SO₂, then R_{24} is not unsubstituted phenyl; and
 (iii) when ring positions 2,3 and 5 are substituted with chlorine and j is a value of 1 and X_{10} is S, then R_{24} is not unsubstituted phenyl;

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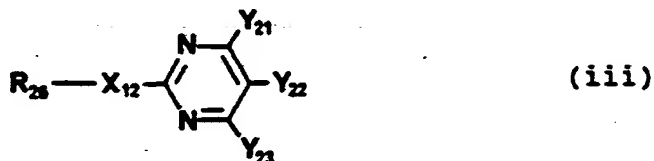
wherein:

R_{25} represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

X_{11} represents O, S, SO, SO_2 , NH, CH_2 , a single covalent bond, $-CH_2O-$, $-CH_2S-$, $-CH(CH_3)O-$, $-CH(CN)O-$, $-CH=NO-$, $-C(CH_3)=NO-$, $-CH_2CH_2O-$, $-CH_2CH_2-$, $-C\equiv C-$, $-CH_2SO-$, $-CH_2SO_2-$, $-OCH_2CH_2O-$, $-CH(alkyl)-$ or $-CONH-$;

b is a value of 2 to 3; and

Y_{20} is the same or different and represents halogen, alkyl, cyano, polyhaloalkyl, polyhaloalkoxy, alkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl provided that at least two of Y_{20} are halogen;



wherein:

R_{26} represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

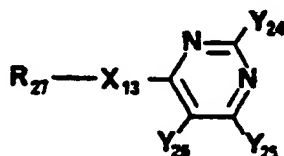
X_{12} represents O, S, SO, SO_2 , NH, CH_2 , a single covalent bond, $-CH_2O-$, $-CH_2S-$.

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-CH(CH₃)O-, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-,
 -CH₂CH₂O-, -CH₂CH₂-, -C≡C-, -CH₂SO-,
 -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)- or -CONH-;

Y₂₁ and Y₂₂ are independently the same or different halogen; and

Y₂₃ represents hydrogen, halogen, alkyl, polyhaloalkyl, alkoxy, polyhaloalkoxy, cyano, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl;



(iv)

wherein:

R₂₇ represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

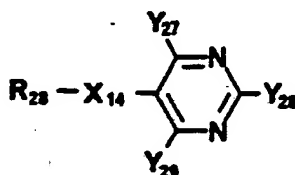
X₁₃ represents O, S, SO, SO₂, NH, CH₂, a single covalent bond, -CH₂O-, -CH₂S-, -CH(CH₃)O-, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -CH₂CH₂-, -C≡C-, -CH₂SO-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)- or -CONH-;

Y₂₄ represents halogen; and

Y₂₅ and Y₂₆ independently represent hydrogen, halogen, alkyl, polyhaloalkyl, alkoxy, polyhaloalkoxy, cyano, alkylthio, alkylsulfinyl,

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alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl provided that at least one of Y_{25} and Y_{26} is halogen and further provided that when Y_{24} , Y_{25} and Y_{26} are chloro and X_{13} is O, then R_{27} is not unsubstituted phenyl;



(v)

wherein:

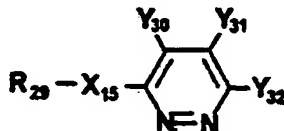
R_{28} represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

X_{14} represents O, S, SO, SO₂, NH, CH₂, a single covalent bond, -CH₂O-, -CH₂S-, -CH(CH₃)O-, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -CH₂CH₂-, -C≡C-, -CH₂SO-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)- or -CONH-;

Y_{27} and Y_{28} are independently halogen;

and

Y_{29} represents hydrogen, halogen, alkyl, polyhaloalkyl, alkoxy, polyhaloalkoxy, cyano, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl;



(vi)

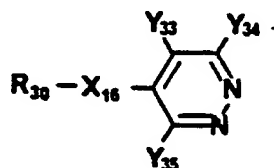
- 739 -

wherein:

R_{29} represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

X_{15} represents O, S, SO, SO₂, NH, CH₂, a single covalent bond, -CH₂O-, -CH₂S-, -CH(CH₃)O-, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -CH₂CH₂-, -C≡C-, -CH₂SO-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)- or -CONH-; and

Y_{30} , Y_{31} and Y_{32} independently represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl provided that at least two of Y_{30} , Y_{31} and Y_{32} are halogen;



(vii)

wherein:

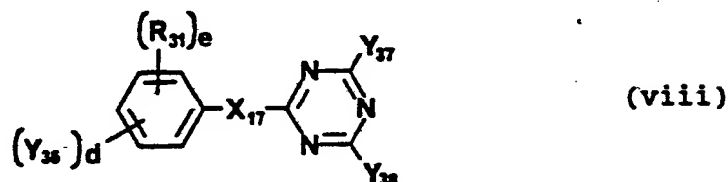
R_{30} represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

X_{16} represents O, S, SO, SO₂, NH, CH₂, a single covalent bond, -CH₂O-, -CH₂S-, -CH(CH₃)O-, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -CH₂CH₂-, -C≡C-, -CH₂SO-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)- or -CONH-; and

Y_{33} , Y_{34} and Y_{35} independently represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, alkylthio,

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alkylsulfinyl, alkylsulfonyl, nitro, acyl or polyhaloalkylsulfonyl provided that (i) at least two of Y_{33} , Y_{34} and Y_{35} are halogen, (ii) when Y_{34} and Y_{35} are both chloro and X_{16} is O, then R_{30} is not unsubstituted phenyl, and (iii) when Y_{33} and Y_{34} are both chloro and X_{16} is O, then R_{30} is not unsubstituted phenyl or 4-methoxyphenyl;



wherein:

d is a value of from 0 to 4 inclusive;

e is a value of 1 or 2 provided that $d + e$ are not greater than 5;

R_{31} is the same or different and represents unsubstituted or substituted aryl provided that when R_{31} is 2- or 4-aryl then d is not 0; aralkyl provided that when R_{31} is 4-aralkyl then d is not 0; alkoxy, cycloalkoxy, aryloxy, aralkoxy provided that when R_{31} is 4-aralkoxy then d is not 0; arylaryloxy, aralkoxyaralkyl, arylaralkoxy, aryloxyaralkyl, aryloxyalkyl, aryloxyaryloxy, aralkoxyaralkoxy, aryloxyalkoxy, alkylthio, alkenylthio, arylthio, aralkylthio, arylthioaralkyl, arylsulfonylarylsulfonyl, alkylamino, dialkylamino, acyloxy, aroyloxy, alkoxycarbonyloxy, phenylazo provided that X_{17} is O or S; naphthylazo, or $-OCH_2O-$ or $-OCH_2CH_2O-$

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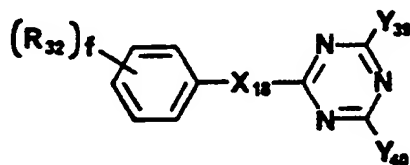
which join adjacent carbon atoms to form a five- or six-membered ring:

Y_{36} is the same or different and represents halogen, alkyl, alkenyl, alkynyl, $-\text{CH}=\text{CHCH}=\text{CH}-$ which joins adjacent carbon atoms to form a six-membered ring, $-(\text{CH}_2)_4$, nitro, cyano, haloalkyl, or polyhaloalkyl:

X_{17} represents O, S, NH, CH_2 , $-\text{CH}_2\text{O}-$, $-\text{CH}_2\text{S}-$ or $-\text{OCH}_2\text{CH}_2\text{O}-$;

Y_{37} represents halogen; and

Y_{38} represents halogen, alkoxy, alkylthio, alkylsulfonyl, polyhaloalkoxy, polyhaloalkyl, cyano, nitro or unsubstituted or substituted arylthio, aryloxy or arylsulfonyl:



(ix)

wherein:

f is a value of from 0 to 5;

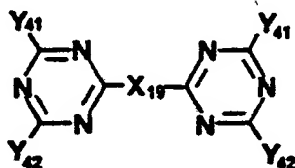
R_{32} is the same or different and represents halogen, alkyl, alkenyl, alkynyl, polyhaloalkyl, cyano, nitro, alkylamino, dialkylamino, alkoxy, polyhaloalkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, acyl, $\text{CO}_2(\text{alkyl})$, $\text{CONH}(\text{alkyl})$, $\text{CON}(\text{alkyl})_2$, $\text{SO}_2\text{N}(\text{alkyl})_2$, alkylcarbonyloxy, alkoxycarbonyloxy, or unsubstituted or substituted aryloxy, arylthio, arylsulfonyl or aroyl:

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X_{18} represents O, S, CH_2 , a single covalent bond or $-C\equiv C-$;

Y_{39} represents halogen, polyhaloalkoxy, polyhaloalkyl, cyano, alkylsulfonyl, alkylsulfonyloxy, polyhaloalkylsulfonyl or polyhaloalkylsulfonyloxy; and

Y_{40} represents haloalkyl, polyhaloalkyl, alkoxy provided that X_{18} is not S or a single covalent bond; polyhaloalkoxy, cyano, alkylthio provided that X_{18} is not O or a single covalent bond; alkylsulfonyl, nitro, dialkoxyphosphinyl or trialkylammonium;



(x)

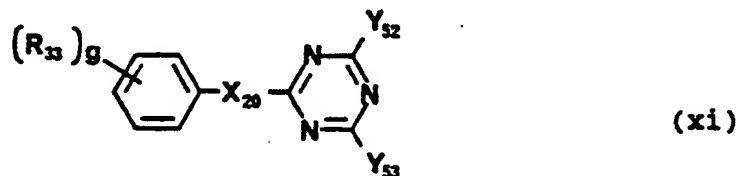
wherein:

Y_{41} is the same or different and represents halogen;

Y_{42} is the same or different and represents halogen, alkoxy, alkylthio or polyhaloalkoxy; and

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X_{19} represents O, -S-S-,
 -P(=O)(O-alkyl)-, -P(alkyl)-, -P(O-alkyl)-,
 sulfinyl, sulfonyl, thiosulfinyl, a single covalent
 bond, carbonyl, aminocarbonylamino, aminooxalyl-
 amino, aminocarbonylalkylenecarbonylamino,
 aminoalkyleneamino, unsubstituted or substituted
 oxyaryloxy provided that 1,3-arylenebis(oxy) is
 substituted with at least one substituent; oxyaryl-
 alkylaryloxy, oxyarylthioaryloxy,
 oxyarylsulfonylaryloxy and oxyarylaryloxy;



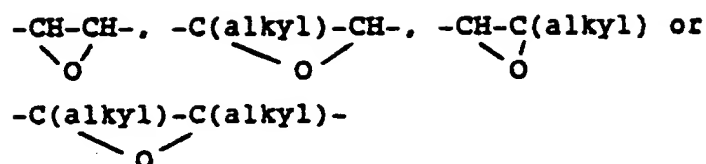
wherein:

Y_{52} and Y_{53} are independently halogen;
 g is a value of from 0 to 5 inclusive;
 R_{33} is the same or different and
 represents halogen, alkyl, alkenyl, alkynyl,
 polyhaloalkyl, cyano, nitro, amino, alkylamino,
 dialkylamino, alkoxy, polyhaloalkoxy, alkylthio,
 alkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl,
 alkoxycarbonyl, alkylaminocarbonyl, aminocarbonyl,
 dialkylaminocarbonyl, dialkylaminosulfonyl,
 alkylaminosulfonyl, aminosulfonyl, alkylcarbonyl,
 dialkoxyalkyl, alkylcarbonyloxy,
 alkylcarbonylalkylamino, -CH=CHCH=CH- which joins
 adjacent carbon atoms to form a six-membered ring,
 or unsubstituted or substituted aryl, aralkyl,
 aryloxy, arylthio, arylsulfonyl or aralkoxy; and
 X_{20} represents -CH(alkyl)O-,
 -C(alkyl)₂O-, -OCH₂-, -CH₂O-, -CH₂-.

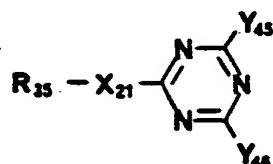
- 744 -

$-\text{C}(\text{halogen})_2$, $-\text{OCH}_2\text{O}-$, $-\text{OCH}_2\text{CH}_2\text{O}-$ or $-\text{C}\equiv\text{C}-$
 provided that g is a value of at least 1;
 $-\text{OCH}(\text{alkyl})-$, $-\text{OC}(\text{alkyl})_2$, $-\text{OCH}(\text{alkyl})\text{O}-$,
 $-\text{OC}(\text{alkyl})_2\text{O}-$, $-\text{OCH}(\text{alkyl})\text{CH}_2\text{O}-$,
 $-\text{OCH}(\text{alkyl})\text{CH}(\text{alkyl})\text{O}-$, $-\text{CH}(\text{alkyl})\text{CH}(\text{alkyl})-$,
 $-\text{CH}(\text{alkyl})-$, $-\text{C}(\text{alkyl})_2-$, $-\text{CH}_2\text{CH}_2\text{O}-$,
 $-\text{OCH}_2\text{CH}_2-$, $-\text{CH}(\text{alkyl})\text{CH}_2\text{O}-$, $-\text{CH}_2\text{CH}_2-$,
 $-\text{CH}(\text{CN})\text{O}-$, $-\text{C}(\text{alkyl})(\text{CN})\text{O}-$, $-\text{CH}(\text{polyhaloalkyl})\text{O}-$,
 $-\text{C}(\text{CN})=\text{NO}-$, $-\text{C}(\text{NH alkyl})=\text{NO}-$, $-\text{C}[\text{N}(\text{alkyl})_2]=\text{NO}-$,
 $-\text{C}(\text{S-alkyl})=\text{NO}-$, $-\text{C}(\text{O-alkyl})=\text{NO}-$, $-\text{SC}(=\text{O})\text{O}-$,
 $-\text{NHC}(=\text{O})\text{O}-$, $-\text{N}(\text{alkyl})\text{C}(=\text{O})\text{O}-$, SO , SO_2 ,
 $-\text{CH}_2\text{S}(\text{O})_h-$, $-\text{CH}(\text{alkyl})\text{S}(\text{O})_h-$, $-\text{S}(\text{O})_h\text{CH}_2-$,
 $-\text{OC}(=\text{S})\text{S}-$, $-\text{C}(=\text{O})\text{S}-$, $-\text{C}(=\text{S})-\text{S}-$, $-\text{NH}(\text{alkyl})\text{C}(=\text{O})\text{S}-$,
 $-\text{O}(\text{C}=\text{O})\text{S}-$, $-\text{N}(\text{R}_{34})-$, $-\text{SO}_2\text{NH}-$, $-\text{SO}_2\text{N}(\text{alkyl})-$,
 $-\text{CONH}-$, $-\text{CON}(\text{alkyl})-$, $-\text{SC}(=\text{O})\text{N}(\text{alkyl})-$, $-\text{S}-\text{C}(=\text{O})\text{NH}-$,
 $-\text{NHSO}_2\text{NH}-$, $-\text{N}(\text{alkyl})\text{SO}_2\text{N}(\text{alkyl})-$,
 $-\text{N}(\text{alkyl})\text{SO}_2\text{NH}-$, $-\text{NHSO}_2\text{N}(\text{alkyl})-$,
 $-\text{C}(\text{O-alkyl})=\text{N}-$, $-\text{C}(\text{S-alkyl})=\text{N}-$, $-\text{CH}(\text{halogen})-$,
 $-\text{C}(\text{alkyl})(\text{halogen})$, $-\text{CH}(\text{CN})-$, $-\text{C}(\text{alkyl})(\text{CN})-$,
 $-\text{NH}(\text{alkyl})\text{NH}-$, $-\text{NH}-\text{N}(\text{alkyl})-$; $-\text{NH}-\text{NH}-$ or $-\text{N}=\text{N}-$
 provided that R_{33} is not nitro; $-\text{C}(=\text{O})-$,
 $-\text{C}(=\text{O})\text{C}(=\text{O})-$, $-\text{CH}(\text{O-alkyl})-$, $-\text{CH}_2\text{C}(=\text{O})-$,
 $-\text{C}(=\text{O})\text{CH}_2$, $-\text{CH}(\text{alkyl})\text{C}(=\text{O})-$, $-\text{C}(=\text{O})\text{CH}(\text{alkyl})-$,
 $-\text{CH}=\text{CH}-$, $-\text{C}(\text{alkyl})=\text{CH}-$, $-\text{CH}=\text{C}(\text{alkyl})-$,
 $-\text{C}(\text{alkyl})=\text{C}(\text{alkyl})-$, $-\text{C}(=\text{O})\text{CH}=\text{CH}-$,
 $-\text{P}(\text{Y}_{43})(\text{Y}_{44}-\text{alkyl})-$, unsubstituted or
 substituted $-\text{P}(\text{Y}_{43})(\text{Y}_{44}-\text{aryl})$ or arylene,
 $-\text{Si}(\text{halogen})_2-$, $-\text{Si}(\text{alkyl})_2$, $-\text{OC}(=\text{O})\text{N}(\text{alkyl})-$,
 $-\text{OCH}_2\text{C}(=\text{O})\text{N}(\text{alkyl})-$, $-\text{N}(\text{alkyl})\text{CON}(\text{alkyl})-$;
 $-\text{OC}(=\text{O})\text{NH}-$, $-\text{NHCONH}-$, $-\text{SO}_2\text{NHC}(=\text{O})\text{NH}-$, or
 $-\text{NHC}(=\text{S})\text{NH}$ provided that g is a value of at least 1:

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wherein h is a value of from 0 to 2 inclusive, R_{34} represents acyl, alkylsulfonyl, polyhaloalkyl, polyhaloacyl, polyhaloalkylsulfonyl or unsubstituted or substituted aroyl or arylsulfonyl and Y_{43} and Y_{44} are independently O or S;



(xii)

wherein:

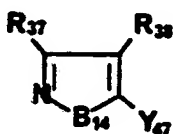
R_{35} represents an unsubstituted or substituted heterocyclic ring system selected from isoxazole, isothiazole, pyrazole, imidazole, 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole, 1,2,4,-thiadiazole, 1,3,4-thiadiazole, oxazole, thiazole, benzopyrazole, benzimidazole, benzoxazole, benzothiazole, indole, pyrrole, furan, thiophene, benzofuran, benzothiophene, pyridine, pyrimidine, pyridazine, pyrazine, 1,3,5-triazine, 1,2,4-triazine, quinoline, isoquinoline, quinazoline, phthalazine, benzopyridazine, benzopyrazine, carbazole, dibenzofuran, dibenzothiophene, benzoxazine, phthalimide, benzopyran, dibenzopyridine, pyridopyridine, pyrazolopyrimidine, tetrahydropyrimidinedione, coumarin, piperidine, morpholine, tetrahydrofuran,

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tetrahydrothiophene, pyrrolidine, thiomorpholine,
 piperidine-2-one, piperidine-2,6-dione,
 2,5-pyrrolidinedione, 3-morpholinone,
 2-oxohexamethyleneimine, 2-oxotetramethyleneimine,
 1-pyrazoline, 2-pyrazoline, pyrazolidine,
 2-imidazolidinone, 2-imidazolidinethione,
 2,4-imidazolidinedione, 1,2-oxathiolane,
 1,3-oxathiolane, 1,3-oxathiane, 1,4-oxathiane,
 2(1H)-pyrazinone, 2H-pyran-2-one, 4H-pyran-4-one,
 2H-pyran-2-thione, 4H-pyran-4-thione,
 tetrahydropyran, tetrahydrothiopyran,
 7-oxabicyclo[2.2.1]heptane,
 7-azabicyclo[2.2.1]heptane, oxetane, coumarin,
 1,3-dioxane, 1,4-dioxane or 1,3-dioxolane;

X_{21} represents O, S or NH provided that
 when X_{21} is NH then R_{35} is not pyridine, and
 when X_{21} is S then R_{35} is not unsubstituted
 benzothiazole; and

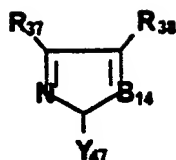
Y_{45} and Y_{46} are independently halogen;



(xiii)

or

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(xiv)

wherein:

R_{37} and R_{38} independently represent halogen, nitro, cyano, polyhaloalkyl, polyhaloalkoxy, alkylsulfonyl, polyhaloalkylsulfonyl, acyl, alkoxycarbonyl, polyhaloalkylsulfonyl or $R_{39}-X_{22}-$ provided that only one of R_{37} and R_{38} may be $R_{39}-X_{22}-$ at any one time;

R_{39} represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

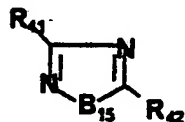
X_{22} represents O, S, SO, SO_2 , CH_2 , a single covalent bond, $-CH_2O-$, $-CH_2S-$, $-CH(CH_3)O-$, $-CH(CN)O-$, $-CH=NO-$, $-C(CH_3)=NO-$, $-CH_2CH_2O-$, $-CH_2CH_2-$, $-C\equiv C-$, $-CH_2SO-$, $-CH_2SO_2-$, $-OCH_2CH_2O-$, $-CH(alkyl)-$ or $-CONH-$;

Y_{47} represents halogen; and

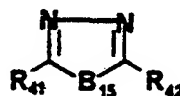
B_{14} represents O, S, NH or NR_{40} wherein R_{40} represents alkyl, alkylsulfonyl, alkenyl, alkynyl, alkoxycarbonyl; unsubstituted or substituted aryl, aralkyl, aryloxy, arylamino, aroyl or arylsulfonyl; provided that (i) when B_{14} is

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$R_{39}-N<$, $R_{39}-alkyl-N<$, $R_{39}-C(=O)-N<$,
 $R_{39}-SO_2N<$, $R_{39}-O-N<$ or $R_{39}-NH-N<$, then both
 R_{37} and R_{38} are other than $R_{39}-X_{22}-$; (ii)
 when B_{14} is other than $R_{39}-N<$, $R_{39}-alkyl-N<$,
 $R_{39}-C(=O)-N<$, $R_{39}-SO_2N<$, $R_{39}-O-N<$ or
 $R_{39}-NH-N<$, then one of R_{37} and R_{38} is
 $R_{39}-X_{22}-$; and (iii) when R_{38} and Y_{47} are
 both chlorine and X_{22} is a single covalent bond in
 formula (xiii), then R_{39} is not unsubstituted
 phenyl:



(xv)



(xvi)

wherein:

R_{41} and R_{42} independently represent
 halogen or $R_{43}-X_{23}-$ provided that only one of
 R_{41} and R_{42} may be $R_{43}-X_{23}-$ at any one time;

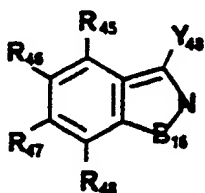
R_{43} represents unsubstituted or
 substituted phenyl, 1- or 2-naphthyl or heteroaryl;

X_{23} represents O, S, SO, SO_2 , CH_2 , a
 single covalent bond, $-CH_2O-$, CH_2S- ,
 $-CH(CH_3)O-$, $-CH(CN)O-$, $-CH=NO-$, $-C(CH_3)=NO-$,
 $-CH_2CH_2O-$, $-CH_2CH_2-$, $-C\equiv C-$, $-CH_2SO-$,

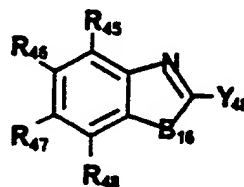
- 749 -

$-\text{CH}_2\text{SO}_2-$, $-\text{OCH}_2\text{CH}_2\text{O}-$, $-\text{CH}(\text{alkyl})-$ or $-\text{CONH}-$;
and

B_{15} represents O, S, NH or NR_{44} wherein R_{44} represents alkyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkenyl, alkynyl, alkoxy, carbonyl; unsubstituted or substituted aryl, aralkyl, aryloxy, arylamino, aroyl or arylsulfonyl; provided that when B_{15} is $\text{R}_{43}-\text{N}<$, $\text{R}_{43}-\text{alkyl}-\text{N}<$, $\text{R}_{43}-\text{C}(=\text{O})-\text{N}<$, $\text{R}_{43}-\text{SO}_2\text{N}<$, $\text{R}_{43}-\text{O}-\text{N}<$ or $\text{R}_{43}-\text{NH}-\text{N}<$, then both R_{41} and R_{42} are other than $\text{R}_{43}-\text{X}_{23}-$; and further provided that when B_{15} is other than $\text{R}_{43}-\text{N}<$, $\text{R}_{43}-\text{alkyl}-\text{N}<$, $\text{R}_{43}-\text{C}(=\text{O})-\text{N}<$, $\text{R}_{43}-\text{SO}_2\text{N}<$, $\text{R}_{43}-\text{O}-\text{N}<$ or $\text{R}_{43}-\text{NH}-\text{N}<$, then one of R_{41} and R_{42} is $\text{R}_{43}-\text{X}_{23}-$;



(xvii)



(xviii)

wherein:

R_{45} , R_{46} , R_{47} , and R_{48} independently represent hydrogen, halogen, nitro, cyano, polyhaloalkyl, polyhaloalkoxy, alkylsulfonyl, polyhaloalkylsulfonyl, acyl, alkylthio, alkyl, alkoxy, alkylsulfinyl or $\text{R}_{49}-\text{X}_{24}-$ provided that one of R_{45} , R_{46} , R_{47} , and R_{48} is $\text{R}_{49}-\text{X}_{24}-$ and further provided that R_{45} , R_{46} ,

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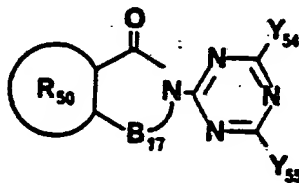
R_{47} , and R_{48} include no more than two of hydrogen, alkyl or alkoxy at any one time;

R_{49} represents unsubstituted or substituted phenyl, 1- or 2-naphthyl or heteroaryl;

X_{24} represents O, S, SO, SO₂, CH₂, a single covalent bond, -CH₂O-, -CH₂S-, -CH(CH₃)O-, -CH(CN)O-, -CH=NO-, -C(CH₃)=NO-, -CH₂CH₂O-, -CH₂CH₂-, -C≡C-, -CH₂SO-, -CH₂SO₂-, -OCH₂CH₂O-, -CH(alkyl)- or -CONH-;

Y_{48} represents halogen; and

B_{16} represents O, S or NH;



(xix)

wherein:

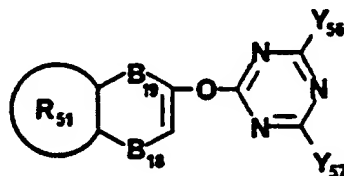
R_{50} represents an unsubstituted or substituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated;

B_{17} represents -CH=N-, -N=CH-, -CH=CH-, -CO-, -SO₂-, -CH₂CO-, -COCH₂-, -CONH-, -NHCO-, -SO₂NH-, -NHSO₂-, -SO₂N(alkyl)-, -N(alkyl)SO₂-, -OSO₂-, -CS-, -N<, -NH-,

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-N(alkyl)-, -OCH₂-, -SCH₂-, -NHCH₂-,
 -N(alkyl)CH₂-, -SCO-, -OCH₂-, -OCO-, -CH₂-,
 -CH₂CH₂- or -SCH₂CO-; provided that when B₁₇
 is -CO- and R₅₀ is phenyl, then the phenyl is
 substituted; and

Y₅₄ and Y₅₅ are independently halogen;



(xx)

wherein:

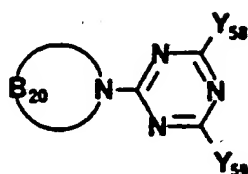
R₅₁ represents or unsubstituted or substituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated;

B₁₈ represents -CH=N-, -N=CH-, -CH=CH-,
 -CO-, -SO₂-, -CH₂CO-, -COCH₂-, -CONH-, -NHCO-,
 -SO₂NH-, -NHSO₂-, -SO₂N(alkyl)-,
 -N(alkyl)SO₂-, -OSO₂-, -CS-, -N<,
 -NH-, -N(alkyl)-, -OCH₂-, -SCH₂-, -NHCH₂-,
 -N(alkyl)CH₂-, -S-CO-, -OCH₂-, -OCO-, -CH₂-,
 -CH₂CH₂- or -SCH₂CO-;

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B_{19} represents $-\text{CH}_2-$ or $-\text{CH}(\text{alkyl})-$;
and i is a value of 0 or 1; and

Y_{56} and Y_{57} are independently halogen;



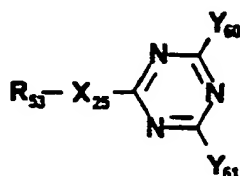
(xxi)

wherein:

B_{20} represents $-\text{CH}_2\text{C}(\text{CH}_3)_2\text{SCH}_2-$,
 $-\text{CH}_2\text{CH}=\text{C}(\text{CH}_3)\text{OCH}_2-$, $-\text{CH}_2\text{CH}_2\text{SCH}_2\text{CH}(\text{CH}_3)-$,
 $-\text{CH}_2\text{CH}_2\text{SCH}_2\text{CH}_2-$, $-\text{CH}_2\text{SCH}_2\text{CO}-$,
 $-\text{COCH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{CO}-$,
 $-\text{COCH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_2\text{CO}-$,
 $-\text{CONH}(\text{C}_6\text{H}_5)\text{CH}_2\text{CH}_2\text{CO}-$, $-\text{COC}(\text{CH}_3)_2\text{NHCO}-$,
 $-\text{CH}_2\text{CH}_2\text{N}(\text{C}_6\text{H}_5)\text{CH}_2\text{CH}_2-$,
 $-\text{CH}_2\text{N}(\text{C}_6\text{H}_5)\text{CH}_2\text{CH}_2-$,
 $-\text{CH}_2\text{CH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_2\text{CH}_2-$, $-\text{CO}(\text{CH}_2)_3\text{CO}-$,
 $-\text{CO}(\text{CH}_2)_2\text{CO}-$, $-\text{COCH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CO}-$,
 $-\text{COCH}(\text{CH}_3)\text{CH}_2\text{CO}-$, $-\text{COC}(\text{CH}_3)_2\text{CH}_2\text{CO}-$,
 $-\text{COC}(\text{CH}_3)_2\text{C}(\text{CH}_3)_2\text{CO}-$, $-\text{CO}(\text{CH}_2)_4\text{CO}-$,
 $-\text{CO}(\text{CH}_2)_5\text{CO}-$, $-\text{CO}(\text{CH}_2)_5\text{CH}_2-$,
 $-\text{CO}(\text{CH}_2)_4\text{CH}_2-$, $-\text{CO}(\text{CH}_2)_3\text{CH}_2-$,
 $-\text{CO}(\text{CH}_2)_2\text{CH}_2-$, $-\text{COCH}_2\text{SCH}_2\text{CO}-$,
 $-\text{COCH}_2\text{N}(\text{R}_{52})\text{CH}_2\text{CO}-$, $-\text{COCH}_2\text{OCH}_2\text{CO}-$,
 $-\text{COCH}_2\text{SCS}-$, $-\text{COCH}=\text{CH}-\text{N}=\text{CH}-$,
 $-\text{CH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_2-\text{N}=\text{CH}-$, or $-\text{CO}_2-\text{CH}_2\text{CH}_2-$;

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R_{52} represents hydrogen, alkenyl;
 unsubstituted or substituted aryl or alkaryl; and
 Y_{58} and Y_{59} are independently halogen;



(xxii)

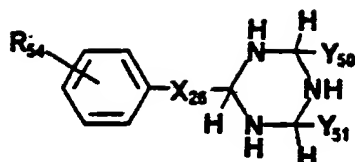
wherein:

R_{53} represents unsubstituted or substituted cycloalkenyl, cycloalkadienyl, cycloalkatrienyl, bicycloalkyl, bicycloalkenyl, bicycloalkadienyl, tricycloalkyl, tricycloalkenyl or tricycloalkadienyl in which the permissible substituents are the same or different and are one or more alkyl, halogen, haloalkyl, polyhaloalkyl, alkoxy, alkylthio, alkylsulfonyl, polyhaloalkoxy, nitro, cyano, acyl, aroyl, aryl, alkoxy-carbonyl, alkoxy-carbonyloxy, acyloxy, oxo, or $-\text{CH}=\text{CHCH}=\text{CH}-$ or $-\text{CH}=\text{CHCH}_2-$ which join adjacent carbon atoms to form a six- or five membered ring;

Y_{60} and Y_{61} are independently halogen;
 and

X_{25} represents O, S, NH, CH_2 , $-\text{CH}_2\text{O}-$ or a single covalent bond;

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(xxiii)

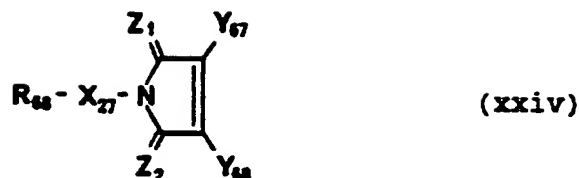
wherein:

R_{54} is the same or different and is one or more hydrogen, halogen, alkyl, aryl, aralkyl, alkenyl, alkynyl, polyhaloalkyl, NH_2 , $NH(alkyl)$, $N(alkyl)_2$, alkoxy, polyhaloalkoxy, alkylthio, alkylsulfinyl, alkylsulfonyl, aralkoxy, CO_2alkyl , $CONH(alkyl)$, $CONH_2$, $CON(alkyl)_2$, $SO_2N(alkyl)_2$, $SO_2NH(alkyl)$, SO_2NH_2 , acyl, $CO(O-alkyl)_2$, acyloxy, acyl- $CON(alkyl)$, or 2,3- $(-CH=CHCH=CH-)$, 3,4- $(-CH=CHCH=CH-)$, 2,3- $(CH_2)_4-$ or 3,4- $(CH_2)_4-$ which join the adjacent carbon atoms to form an unsubstituted or substituted six-membered ring;

X_{26} represents O, S, SO, SO_2 , CH_2 , a single covalent bond, $-CH_2O-$, $-CH_2S-$, $-CH(CH_3)O-$, $-CH(CN)O-$, $-CH=NO-$, $-C(CH_3)=NO-$, $-CH_2CH_2O-$, $-CH_2CH_2-$, $-C\equiv C-$, $-CH_2SO-$, $-CH_2SO_2-$, $-OCH_2CH_2O-$, $-OCH_2CH_2-$ or $-OCH_2-$; and

Y_{50} and Y_{51} are the same or different and are halogen;

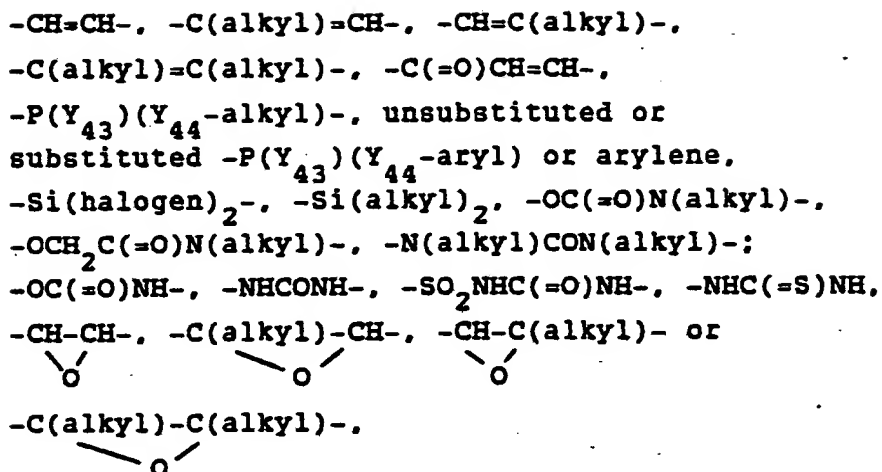
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R_{68} represents unsubstituted or substituted phenyl or 1- or 2-naphthyl;

X_{27} represents -CH(alkyl)O-,
 -C(alkyl)₂O-, -OCH₂-, -C(halogen)₂-, -OCH₂O-,
 -OCH₂CH₂O-, -CH₂O-, -C≡C-, -OCH(alkyl)-,
 -OC(alkyl)₂-, -OCH(alkyl)O-, -OC(alkyl)₂O-,
 -OCH(alkyl)CH₂O-, -OCH(alkyl)CH(alkyl)O-,
 -CH(alkyl)CH(alkyl)-, -CH(alkyl)-, -C(alkyl)₂-,
 -CH₂CH₂O-, -OCH₂CH₂-, -CH(alkyl)CH₂O-,
 -CH₂CH₂-, -CH(CN)O-, -C(alkyl)(CN)O-,
 -CH(polyhaloalkyl)O-, -C(CN)=NO-, -C(NH alkyl)=NO-,
 -C[N(alkyl)₂]=NO-, -C(S-alkyl)=NO-,
 -C(O-alkyl)=NO-, -SC(=O)O-, -NHC(=O)O-,
 -N(alkyl)C(=O)O-, SO, SO₂, -CH₂S(O)_h-,
 -CH(alkyl)S(O)_h-, -S(O)_hCH₂-, -OC(=S)S-,
 -C(=O)S-, -C(=S)-S-, -NH(alkyl)C(=O)S-, -O(C=O)S-,
 -N(alkyl)-, -N(R₃₄)-, -SO₂NH-, -SO₂N(alkyl)-,
 -CONH-, -CON(alkyl)-, -SC(=O)N(alkyl)-, -S-C(=O)NH-,
 -NHSO₂NH-, -N(alkyl)SO₂N(alkyl)-,
 -N(alkyl)SO₂NH-, -NHSO₂N(alkyl)-,
 -C(O-alkyl)=N-, -C(S-alkyl)=N-, -CH(halogen)-,
 -C(alkyl)(halogen)-, -CH(CN)-, -C(alkyl)(CN)-,
 -NH(alkyl)NH-, -NH-N(alkyl)-; -NH-NH-, -N=N-,
 -C(=O)-, -C(=O)C(=O)-, -CH(O-alkyl)-, -CH₂C(=O)-,
 -C(=O)CH₂-, -CH(alkyl)C(=O)-, -C(=O)CH(alkyl)-,

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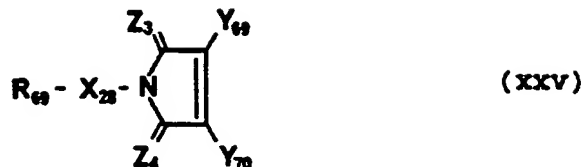


wherein h is a value of from 0 to 2 inclusive, R_{34} represents acyl, alkylsulfonyl, polyhaloalkyl, polyhaloacyl, polyhaloalkylsulfonyl or unsubstituted or substituted aroyl or arylsulfonyl and Y_{43} and Y_{44} are independently O or S;

Z_1 and Z_2 are independently O, S, C_1-C_8 alkylidene, substituted or unsubstituted benzylidene, NH or NR'''' wherein R'''' is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

Y_{67} and Y_{68} are the same or different and represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, aryl, polyhaloalkylsulfonyl, alkylamino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, phosphono or phosphino;

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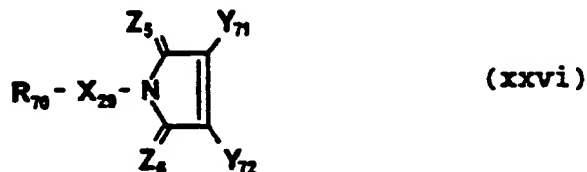
R_{69} represents unsubstituted or substituted phenyl or 1- or 2-naphthyl;

X_{28} is NH, CH_2 or a covalent bond;

Z_3 and Z_4 are independently O, S,

C_1-C_8 alkylidene, substituted or unsubstituted benzylidene, NH or NR''' wherein R''' is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

Y_{69} and Y_{70} are the same or different and represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, aryl, polyhaloalkylsulfonyl, alkylamino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, phosphono or phosphino, with the proviso that Y_{69} and Y_{70} taken together do not represent either the same halogen or halogen and hydrogen;



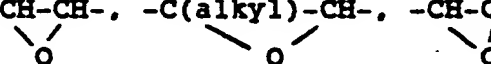

R_{70} represents an unsubstituted or substituted, unsaturated or saturated, aromatic or non-aromatic heterocyclic ring system selected from

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isoxazole, isothiazole, pyrazole, imidazole,
 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole,
 1,2,4,-thiadiazole, 1,3,4-thiadiazole, oxazole,
 thiazole, benzopyrazole, benzimidazole, benzoxazole,
 benzothizole, indole, pyrrole, furan, thiophene,
 benzofuran, benzothiophene, pyridine, pyrimidine,
 pyridazine, pyrazine, 1,3,5-triazine,
 1,2,4-triazine, quinoline, isoquinoline,
 quinazoline, phthalazine, benzopyridazine,
 benzopyrazine, carbazole, dibenzofuran,
 dibenzothiophene, benzoxazine, phthalimide,
 benzopyran, dibenzopyridine, pyridopyridine,
 pyrazolopyrimidine, tetrahydropyrimidinedione,
 piperidine, morpholine, tetrahydrofuran,
 tetrahydrothiophene, pyrrolidine, thiomorpholine,
 piperidine-2-one, piperidine-2,6-dione,
 2,5-pyrrolidinedione, 3-morpholinone,
 2-oxohexamethyleneimine, 2-oxotetramethyleneimine,
 1-pyrazoline, 2-pyrazoline, pyrazolidine,
 2-imidazolidinone, 2-imidazolidinethione,
 2,4-imidazolidinedione, 1,2-oxathiolane,
 1,3-oxathiolane, 1,3-oxathiane, 1,4-oxathiane,
 2(1H)-pyrazinone, 2H-pyran-2-one, 4H-pyran-4-one,
 2H-pyran-2-thione, 4H-pyran-4-thione,
 tetrahydropyran, tetrahydrothiopyran,
 7-oxabicyclo[2.2.1]heptane,
 7-azabicyclo[2.2.1]heptane, oxetane, coumarin,
 1,3-dioxane, 1,4-dioxane or 1,3-dioxolane;

X₂₉ represents -CH(alkyl)O-,
 -C(alkyl)₂O-, -OCH₂-, -CH₂O-, -CH₂-, a
 covalent bond, -C(halogen)₂-, -OCH₂O-,
 -OCH₂CH₂O-, -C≡C-, -OCH(alkyl)-, -OC(alkyl)₂.

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-OCH(alkyl)O- , $\text{-OC(alkyl)}_2\text{O-}$, $\text{-OCH(alkyl)CH}_2\text{O-}$,
 $\text{-OCH(alkyl)CH(alkyl)O-}$, $\text{-CH(alkyl)CH(alkyl)-}$,
 -CH(alkyl)- , $\text{-C(alkyl)}_2\text{-}$, $\text{-CH}_2\text{CH}_2\text{O-}$,
 $\text{-OCH}_2\text{CH}_2\text{-}$, $\text{-CH(alkyl)CH}_2\text{O-}$, $\text{-CH}_2\text{CH}_2\text{-}$,
 -CH(CN)O- , -C(alkyl)(CN)O- , $\text{-CH(polyhaloalkyl)O-}$,
 -C(CN)=NO- , -C(NH alkyl)=NO- , $\text{-C[N(alkyl)}_2\text{]=NO-}$,
 -C(S-alkyl)=NO- , -C(O-alkyl)=NO- , -SC(=O)O- ,
 -NHC(=O)O- , -N(alkyl)C(=O)O- , SO , SO_2 ,
 $\text{-CH}_2\text{S(O)}_h\text{-}$, $\text{-CH(alkyl)S(O)}_h\text{-}$, $\text{-S(O)}_h\text{CH}_2\text{-}$,
 -OC(=S)S- , -C(=O)S- , -C(=S)S- , -NH(alkyl)C(=O)S- ,
 -O(C=O)S- , -NH- , -N(alkyl)- , $\text{-N(R}_{34}\text{)-}$, $\text{-SO}_2\text{NH-}$,
 $\text{-SO}_2\text{N(alkyl)-}$, -CONH- , -CON(alkyl)- ,
 -SC(=O)N(alkyl)- , -S-C(=O)NH- , $\text{-NHSO}_2\text{NH-}$,
 $\text{-N(alkyl)SO}_2\text{N(alkyl)-}$, $\text{-N(alkyl)SO}_2\text{NH-}$,
 $\text{-NHSO}_2\text{N(alkyl)-}$, -C(O-alkyl)=N- , -C(S-alkyl)=N- ,
 -CH(halogen)- , $\text{-C(alkyl)(halogen)-}$, -CH(CN)- ,
 -C(alkyl)(CN)- , -NH(alkyl)NH- , -NH-N(alkyl)- ;
 -NH-NH- , -N=N- , -C(=O)- , -C(=O)C(=O)- ,
 -CH(O-alkyl)- , $\text{-CH}_2\text{C(=O)-}$, $\text{-C(=O)CH}_2\text{-}$,
 -CH(alkyl)C(=O)- , -C(=O)CH(alkyl)- , -CH=CH- ,
 -C(alkyl)=CH- , -CH=C(alkyl)- , $\text{-C(alkyl)=C(alkyl)-}$,
 -C(=O)CH=CH- , $\text{-P(Y}_{43}\text{)(Y}_{44}\text{-alkyl)-}$, unsubstituted
or substituted $\text{-P(Y}_{43}\text{)(Y}_{44}\text{-aryl)}$ or arylene,
 $\text{-Si(halogen)}_2\text{-}$, $\text{-Si(alkyl)}_2\text{-}$, -OC(=O)N(alkyl)- ,
 $\text{-OCH}_2\text{C(=O)N(alkyl)-}$, $\text{-N(alkyl)CON(alkyl)-}$;
 -OC(=O)NH- , -NHCONH- , $\text{-SO}_2\text{NHC(=O)NH-}$, -NHC(=S)NH- ,
 -CH-CH- , -C(alkyl)-CH- , -CH-C(alkyl)- or

 $\text{-C(alkyl)-C(alkyl)-}$,


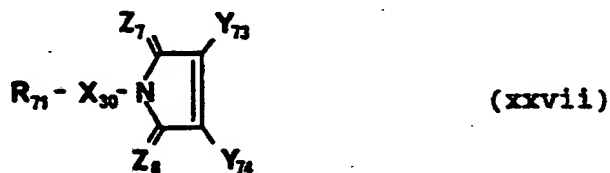
wherein h is a value of from 0 to 2 inclusive, R_{34}
 represents acyl, alkylsulfonyl, polyhaloalkyl.

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polyhaloacyl, polyhaloalkylsulfonyl or unsubstituted or substituted aroyl or arylsulfonyl and Y_{43} and Y_{44} are independently O or S;

Z_5 and Z_6 are independently O, S, C_1-C_8 alkylidene, substituted or unsubstituted benzylidene, NH or NR''' wherein R''' is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

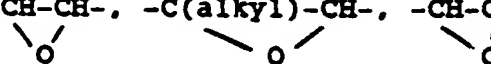
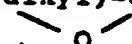
Y_{71} and Y_{72} are the same or different and represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl, polyhaloalkylsulfonyl, amino, alkylamino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, alkoxycarbonyl, alkylaminocarbonyl, aminocarbonyl, dialkylaminocarbonyl, dialkylaminosulfonyl, alkylaminosulfonyl, aminosulfonyl, dialkoxyalkyl, arylsulfonyl, phosphono or phosphino;



R_{71} represents unsubstituted or substituted alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, cycloalkadienyl, cycloalkatrienyl, bicycloalkyl, bicycloalkenyl, bicycloalkadienyl, tricycloalkyl, tricycloalkenyl or tricycloalkadienyl;

X_{30} represents $-CH(alkyl)O-$, $-C(alkyl)_2O-$, $-OCH_2-$, $-CH_2O-$, $-CH_2-$, a covalent bond, $-C(halogen)_2$, $-OCH_2O-$, $-OCH_2CH_2O-$, $-C\equiv C-$, $-OCH(alkyl)-$, $-OC(alkyl)_2$.

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$-\text{OCH(alkyl)O-}$, $-\text{OC(alkyl)}_2\text{O-}$, $-\text{OCH(alkyl)CH}_2\text{O-}$,
 $-\text{OCH(alkyl)CH(alkyl)O-}$, $-\text{CH(alkyl)CH(alkyl)-}$,
 $-\text{CH(alkyl)-}$, $-\text{C(alkyl)}_2-$, $-\text{CH}_2\text{CH}_2\text{O-}$,
 $-\text{OCH}_2\text{CH}_2-$, $-\text{CH(alkyl)CH}_2\text{O-}$, $-\text{CH}_2\text{CH}_2-$,
 $-\text{CH(CN)O-}$, $-\text{C(alkyl)(CN)O-}$, $-\text{CH(polyhaloalkyl)O-}$,
 $-\text{C(CN)=NO-}$, $-\text{C(NH alkyl)=NO-}$, $-\text{C[N(alkyl)}_2\text{]=NO-}$,
 $-\text{C(S-alkyl)=NO-}$, $-\text{C(O-alkyl)=NO-}$, $-\text{SC(=O)O-}$,
 $-\text{NHC(=O)O-}$, $-\text{N(alkyl)C(=O)O-}$, SO , SO_2 ,
 $-\text{CH}_2\text{S(O)}_h-$, $-\text{CH(alkyl)S(O)}_h-$, $-\text{S(O)}_h\text{CH}_2-$,
 $-\text{OC(=S)S-}$, $-\text{C(=O)S-}$, $-\text{C(=S)-S-}$, $-\text{NH(alkyl)C(=O)S-}$,
 $-\text{O(C=O)S-}$, $-\text{NH-}$, $-\text{N(alkyl)-}$, $-\text{N(R}_{34})-$, $-\text{SO}_2\text{NH-}$,
 $-\text{SO}_2\text{N(alkyl)-}$, $-\text{CONH-}$, $-\text{CON(alkyl)-}$,
 $-\text{SC(=O)N(alkyl)-}$, $-\text{S-C(=O)NH-}$, $-\text{NHSO}_2\text{NH-}$,
 $-\text{N(alkyl)SO}_2\text{N(alkyl)-}$, $-\text{N(alkyl)SO}_2\text{NH-}$,
 $-\text{NHSO}_2\text{N(alkyl)-}$, $-\text{C(O-alkyl)=N-}$, $-\text{C(S-alkyl)=N-}$,
 $-\text{CH(halogen)-}$, $-\text{C(alkyl)(halogen)-}$, $-\text{CH(CN)-}$,
 $-\text{C(alkyl)(CN)-}$, $-\text{NH(alkyl)NH-}$, $-\text{NH-N(alkyl)-}$;
 $-\text{NH-NH-}$, $-\text{N=N-}$, $-\text{C(=O)-}$, $-\text{C(=O)C(=O)-}$,
 $-\text{CH(O-alkyl)-}$, $-\text{CH}_2\text{C(=O)-}$, $-\text{C(=O)CH}_2$,
 $-\text{CH(alkyl)C(=O)-}$, $-\text{C(=O)CH(alkyl)-}$, $-\text{CH=CH-}$,
 $-\text{C(alkyl)=CH-}$, $-\text{CH=C(alkyl)-}$, $-\text{C(alkyl)=C(alkyl)-}$,
 $-\text{C(=O)CH=CH-}$, $-\text{P(Y}_{43})(\text{Y}_{44}\text{-alkyl)-}$, unsubstituted
or substituted $-\text{P(Y}_{43})(\text{Y}_{44}\text{-aryl)}$ or arylene,
 $-\text{Si(halogen)}_2-$, $-\text{Si(alkyl)}_2-$, $-\text{OC(=O)N(alkyl)-}$,
 $-\text{OCH}_2\text{C(=O)N(alkyl)-}$, $-\text{N(alkyl)CON(alkyl)-}$;
 $-\text{OC(=O)NH-}$, $-\text{NHCONH-}$, $-\text{SO}_2\text{NHC(=O)NH-}$, $-\text{NHC(=S)NH}$
 $-\text{CH-CH-}$, $-\text{C(alkyl)-CH-}$, $-\text{CH-C(alkyl)-}$ or

 $-\text{C(alkyl)-C(alkyl)-}$,


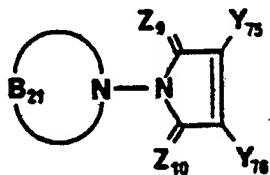
wherein h is a value of from 0 to 2 inclusive, R_{34}
represents acyl, alkylsulfonyl, polyhaloalkyl,

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polyhaloacyl, polyhaloalkylsulfonyl or unsubstituted or substituted aroyl or arylsulfonyl and Y_{43} and Y_{44} are independently O or S;

Z_7 and Z_8 are independently O, S, C_1-C_8 alkylidene, substituted or unsubstituted benzylidene, NH or NR''' wherein R''' is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

Y_{73} and Y_{74} are the same or different and represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, aryl, polyhaloalkylsulfonyl, alkylamino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy and polyhaloalkylsulfonyloxy;



(xxviii)

wherein:

B_{21} represents $-CH_2C(CH_3)_2SCH_2-$,
 $-CH_2CH=C(CH_3)OCH_2-$,
 $-CH_2CH_2SCH_2CH(CH_3)-$,
 $-CH_2CH_2SCH_2CH_2-$, $-CH_2SCH_2CO-$,
 $-COCH_2C(CH_3)_2CH_2CO-$,
 $-COCH_2CH(C_6H_5)CH_2CO-$,
 $-CONH(C_6H_5)CH_2CH_2O-$, $-COC(CH_3)_2NHCO-$,
 $-CH_2CH_2N(C_6H_5)CH_2CH_2-$,
 $-CH_2N(C_6H_5)CH_2CH_2-$,
 $-CH_2CH_2CH(C_6H_5)CH_2CH_2-$,
 $-CO(CH_2)_3CO-$, $-CO(CH_2)_2CO-$.

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$-\text{COCH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CO}-$, $-\text{COCH}(\text{CH}_3)\text{CH}_2\text{CO}-$,
 $-\text{COC}(\text{CH}_3)_2\text{CH}_2\text{CO}-$,
 $-\text{COC}(\text{CH}_3)_2\text{C}(\text{CH}_3)_2\text{CO}-$, $-\text{CO}(\text{CH}_2)_4\text{CO}-$,
 $-\text{CO}(\text{CH}_2)_5\text{CO}-$, $-\text{CO}(\text{CH}_2)_5\text{CH}_2-$,
 $-\text{CO}(\text{CH}_2)_4\text{CH}_2-$, $-\text{CO}(\text{CH}_2)_3\text{CH}_2-$,
 $-\text{CO}(\text{CH}_2)_2\text{CH}_2-$, $-\text{COCH}_2\text{SCH}_2\text{CO}-$,
 $-\text{COCH}_2\text{N}(\text{R}_{52})\text{CH}_2\text{CO}-$, $-\text{COCH}_2\text{OCH}_2\text{CO}-$,
 $-\text{COCH}_2\text{SCS}-$, $-\text{COCH}=\text{CH}-\text{N}=\text{CH}-$,

$-\text{CH}_2\text{CH}(\text{C}_6\text{H}_5)\text{CH}_2-\text{N}=\text{CH}-$ or $-\text{CO}_2-\text{CH}_2\text{CH}_2-$

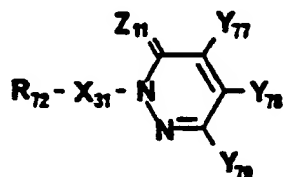
wherein R_{52} represents hydrogen, alkenyl;

unsubstituted or substituted aryl or alkaryl;

Z_9 and Z_{10} are independently O, S,

C_1-C_8 alkylidene, substituted or unsubstituted benzylidene, NH or NR''' wherein R''' is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

Y_{75} and Y_{76} are the same or different and represent hydrogen, halogen, alkyl, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl, polyhaloalkylsulfonyl, amino, alkylamino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, phosphono or phosphino;

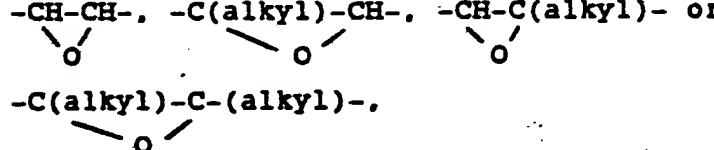


(xxix)

R_{72} represents unsubstituted or substituted phenyl or 1- or 2-naphthyl;

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X_{31} represents $-OCH_2-$, $-CH_2-$, a covalent bond, $-C(halogen)_2$, $-C\equiv C-$, $-OCH(alkyl)-$, $-OC(alkyl)_2$, $-CH(alkyl)CH(alkyl)-$, $-CH(alkyl)-$, $-C(alkyl)_2$, $-OCH_2CH_2-$, $-CH_2CH_2-$, SO , $-S-$, SO_2 , $-CH_2S(O)_h-$, $-CH(alkyl)S(O)_h-$, $-S(O)_hCH_2-$, $-CH(halogen)-$, $-C(alkyl)(halogen)$, $-CH(CN)-$, $-C(alkyl)(CN)-$, or $-C(=O)-$, $-CH(O-alkyl)-$, $-CH_2C(=O)-$, $-C(=O)CH_2$, $-CH(alkyl)C(=O)-$, $-C(=O)CH(alkyl)-$, $-CH=CH-$, $-C(alkyl)=CH-$, $-CH=C(alkyl)-$, $-C(alkyl)=C(alkyl)-$, $-C(=O)CH=CH-$, arylene, $-Si(halogen)_2-$, $-Si(alkyl)_2$, $-CH-CH-$, $-C(alkyl)-CH-$, $-CH-C(alkyl)-$ or



$-C(alkyl)-C(alkyl)-$.

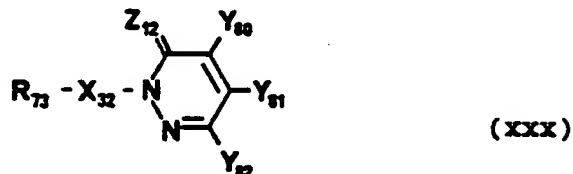
wherein h is a value of from 0 to 2 inclusive;

Z_{11} represents O , S , C_1-C_8 alkylidene, substituted or unsubstituted benzylidene, NH or NR''' wherein R''' is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

Y_{77} , Y_{78} and Y_{79} are the same or different and represent hydrogen, halogen, alkyl, hydroxy, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl, polyhaloalkylsulfonyl, alkylamino, amino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy, phosphono or phosphino, with the proviso that when Y_{77} is halogen and Y_{79} is hydrogen then Y_{78} cannot be amino, alkylamino, dialkylamino or acylamino and with the

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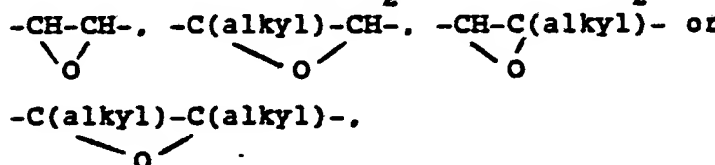
further proviso that when Y_{77} and Y_{78} are the same halogen then Y_{79} cannot be hydrogen or hydroxy:



R_{73} represents an unsubstituted or substituted, unsaturated or saturated, aromatic or non-aromatic heterocyclic ring system selected from isoxazole, isothiazole, pyrazole, imidazole, 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole, 1,2,4,-thiadiazole, 1,3,4-thiadiazole, oxazole, thiazole, benzopyrazole, benzimidazole, benzoxazole, benzothiazole, indole, pyrrole, furan, thiophene, benzofuran, benzothiophene, pyridine, pyrimidine, pyridazine, pyrazine, 1,3,5-triazine, 1,2,4-triazine, quinoline, isoquinoline, quinazoline, phthalazine, benzopyridazine, benzopyrazine, carbazole, dibenzofuran, dibenzothiophene, benzoxazine, phthalimide, benzopyran, dibenzopyridine, pyridopyridine, pyrazolopyrimidine, tetrahydropyrimidinedione, piperidine, morpholine, tetrahydrofuran, tetrahydrothiophene, pyrrolidine, thiomorpholine, piperidine-2-one, piperidine-2,6-dione, 2,5-pyrrolidinedione, 3-morpholinone, 2-oxohexamethyleneimine, 2-oxotetramethyleneimine, 1-pyrazoline, 2-pyrazoline, pyrazolidine, 2-imidazolidinone, 2-imidazolidinethione, 2,4-imidazolidinedione, 1,2-oxathiolane, 1,3-oxathiolane, 1,3-oxathiane, 1,4-oxathiane,

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2(1H)-pyrazinone, 2H-pyran-2-one, 4H-pyran-4-one,
 2H-pyran-2-thione, 4H-pyran-4-thione,
 tetrahydropyran, tetrahydrothiopyran,
 7-oxabicyclo[2.2.1]heptane,
 7-azabicyclo[2.2.1]heptane, oxetane, coumarin,
 1,3-dioxane, 1,4-dioxane or 1,3-dioxolane;

X_{32} represents $-OCH_2-$, $-CH_2-$, a
 covalent bond, $-C(halogen)_2$, $-C\equiv C-$, $-OCH(alkyl)-$,
 $-OC(alkyl)_2$, $-CH(alkyl)CH(alkyl)-$, $-CH(alkyl)-$,
 $-C(alkyl)_2-$, $-OCH_2CH_2-$, $-CH_2CH_2-$, SO, $-S-$,
 SO_2 , $-CH_2S(O)_h-$, $-CH(alkyl)S(O)_h-$,
 $-S(O)_hCH_2-$, $-CH(halogen)-$, $-C(alkyl)(halogen)-$,
 $-CH(CN)-$, $-C(alkyl)(CN)-$, $-C(=O)-$, $-CH(O-alkyl)-$,
 $-CH_2C(=O)-$, $-C(=O)CH_2-$, $-CH(alkyl)C(=O)-$,
 $-C(=O)CH(alkyl)-$, $-CH=CH-$, $-C(alkyl)=CH-$,
 $-CH=C(alkyl)-$, $-C(alkyl)=C(alkyl)-$, $-C(=O)CH=CH-$,
 arylene, $-Si(halogen)_2-$, $-Si(alkyl)_2$,
 $-CH-CH-$, $-C(alkyl)-CH-$, $-CH-C(alkyl)-$ or

 $-C(alkyl)-C(alkyl)-$.

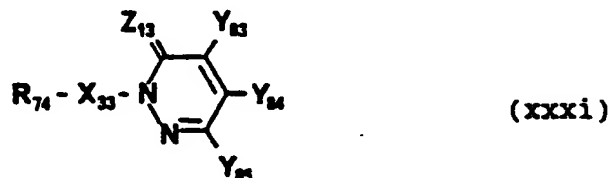
wherein h is a value of from 0 to 2 inclusive;

Z_{12} represents O, S, C_1-C_8
 alkylidene, substituted or unsubstituted
 benzyldene, NH or NR''' wherein R''' is alkyl,
 aryl, aralkyl, alkenyl or alkynyl; and

Y_{80} , Y_{81} and Y_{82} are the same or
 different and represent hydrogen, halogen, alkyl,
 hydroxy, cyano, polyhaloalkyl, alkoxy,
 polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl,
 alkylsulfonyl, nitro, acyl, polyhaloalkylsulfonyl,
 alkylamino, amino, dialkylamino, acylamino, acyloxy,

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alkylsulfonyloxy, arylsulfonyloxy,
 alkenylsulfonyloxy, haloalkylsulfonyloxy,
 polyhaloalkylsulfonyloxy, phosphono or phosphino;



R_{74} represents unsubstituted or substituted alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, cycloalkadienyl, cycloalkatrienyl, bicycloalkyl, bicycloalkenyl, bicycloalkadienyl, tricycloalkyl, tricycloalkenyl or tricycloalkadienyl;

X_{33} represents $-OCH_2-$, $-CH_2-$, a covalent bond, $-C(halogen)_2-$, $-C\equiv C-$, $-OCH(alkyl)-$, $-OC(alkyl)_2-$, $-CH(alkyl)CH(alkyl)-$, $-CH(alkyl)-$, $-C(alkyl)_2-$, $-OCH_2CH_2-$, $-CH_2CH_2-$, SO , $-S-$, SO_2 , $-CH_2S(O)_h-$, $-CH(alkyl)S(O)_h-$, $-S(O)_hCH_2-$, $-CH(halogen)-$, $-C(alkyl)(halogen)-$, $-CH(CN)-$, $-C(alkyl)(CN)-$, or $-C(=O)-$, $-CH(O-alkyl)-$, $-CH_2C(=O)-$, $-C(=O)CH_2-$, $-CH(alkyl)C(=O)-$, $-C(=O)CH(alkyl)-$, $-CH=CH-$, $-C(alkyl)=CH-$, $-CH=C(alkyl)-$, $-C(alkyl)=C(alkyl)-$, $-C(=O)CH=CH-$, arylene, $-Si(halogen)_2-$, $-Si(alkyl)_2-$, $-CH-CH-$, $-C(alkyl)-CH-$, $-CH-C(alkyl)-$ or

$-C(alkyl)-C(alkyl)-$;

wherein h is a value of from 0 to 2 inclusive;

Z_{13} represents O , S , C_1-C_8 alkylidene, substituted or unsubstituted

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benzylidene, NH or NR''' wherein R''' is alkyl, aryl, aralkyl, alkenyl or alkynyl; and

Y₈₃, Y₈₄ and Y₈₅ are the same or different and represent hydrogen, halogen, alkyl, hydroxy, cyano, polyhaloalkyl, alkoxy, polyhaloalkoxy, haloalkyl, alkylthio, alkylsulfinyl, alkylsulfonyl, nitro, acyl, polyhaloalkylsulfonyl, alkylamino, amino, dialkylamino, acylamino, acyloxy, alkylsulfonyloxy, arylsulfonyloxy, alkenylsulfonyloxy, haloalkylsulfonyloxy or polyhaloalkylsulfonyloxy; in which the permissible substituents for formulae (i) through (xxxi) above are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,

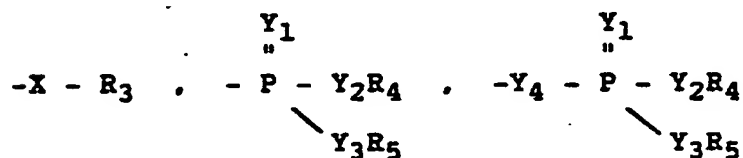
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polyhaloalkylsulfonyl, alkylsulfonylamino,
alkylcarbonylamino, polyhaloalkylsulfonylamino,
polyhaloalkylcarbonylamino, trialkylsilyl,
aryldialkylsilyl, triarylsilyl, sulfonic acid and
derivative salts, phosphonic acid and derivative
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,
polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted or
substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxylalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl,
haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl,
dialkylaminosulfonyl, arylaminosulfonyl,
carboxyalkoxy, carboxyalkylthio,
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
alkenylsulfonyloxy, arylsulfonyloxy,
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
aroylamino, haloacylamino, alkoxycarbonyloxy,
arylsulfonylamino, aminocarbonyloxy, cyanato.

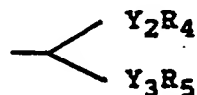
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isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

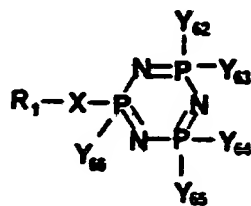
$-X, = X, -X = R_3, = X-R_3,$



or



$R_1 - X - R_{36} \quad (xxxii)$



(xxxiii)

wherein:

$Y_{62}, Y_{63}, Y_{64}, Y_{65}$ and Y_{66} are
 the same or different and are halogen;

R_1 is a substituted or unsubstituted,
 carbocyclic or heterocyclic ring system selected
 from a monocyclic aromatic or nonaromatic ring
 system, a bicyclic aromatic or nonaromatic ring

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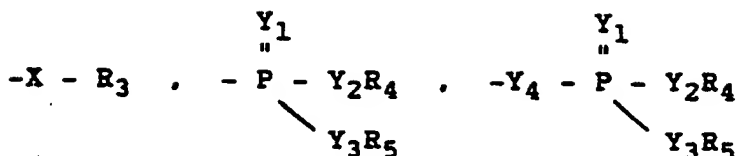
system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy.

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polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, or a hydroxy
group condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl,
dialkylaminosulfonyl, arylaminosulfonyl,
carboxyalkoxy, carboxyalkylthio,
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
alkenylsulfonyloxy, arylsulfonyloxy,
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
aroylamino, haloacylamino, alkoxycarbonyloxy,
arylsulfonylamino, aminocarbonyloxy, cyanato,
isocyanato, isothiocyano, cycloalkylamino,
trialkylammonium, arylamino, aryl(alkyl)amino,
aralkylamino, alkoxyalkylphosphinyl,
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
dialkoxyphosphino, hydroxyamino, alkoxyamino,
aryloxyamino, aryloxyimino, oxo, thiono,
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

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-X, = X, -X = R₃, = X-R₃.



or



R₁ is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl,

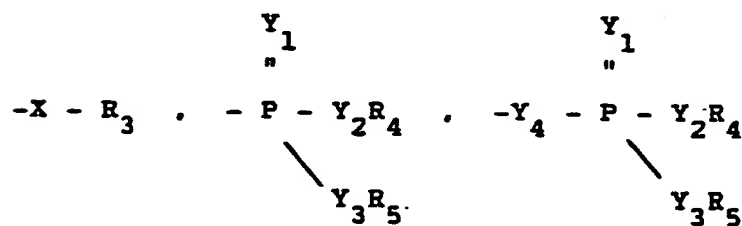
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alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy.

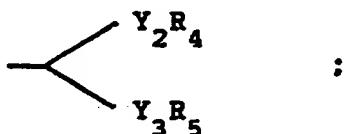
- 775 -

haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium.

$-X, = X, -X = R_3, = X-R_3,$



or



X is a covalent single bond or double bond,
 a substituted or unsubstituted heteroatom or
 substituted carbon atom, or a substituted or
 unsubstituted, branched or straight chain containing
 two or more carbon atoms or heteroatoms in any
 combination in which the permissible substituents
 are the same or different and are one or more

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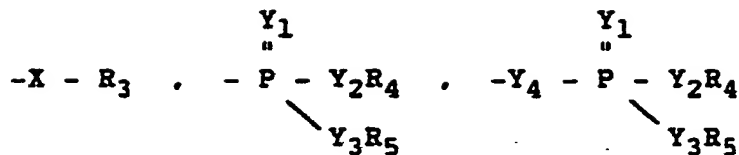
hydrogen, halogen, alkylcarbonyl,
alkylcarbonylalkyl, alkoxycarbonylalkyl,
alkoxycarbonylalkylthio, polyhaloalkenylthio,
thiocyano, propargylthio, hydroxyimino, alkoxyimino,
trialkylsilyloxy, aryldialkylsilyloxy,
triarylsilyloxy, formamidino, alkylsulfamido,
dialkylsulfamido, alkoxysulfonyl,
polyhaloalkoxysulfonyl, hydroxy, amino,
aminocarbonyl, alkylaminocarbonyl,
dialkylaminocarbonyl, aminothiocabonyl,
alkylaminothiocabonyl, dialkylaminothiocabonyl,
nitro, cyano, hydroxycarbonyl and derivative salts,
formamido, alkyl, alkoxy, polyhaloalkyl,
polyhaloalkoxy, alkoxycarbonyl, substituted amino in
which the permissible substituents are the same or
different and are one or two propargyl, alkoxyalkyl,
alkylthioalkyl, alkyl, alkenyl, haloalkenyl or
polyhaloalkenyl; alkylthio, polyhaloalkylthio,
alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl,
polyhaloalkylsulfonyl, alkylsulfonylamino,
alkylcarbonylamino, polyhaloalkylsulfonylamino,
polyhaloalkylcarbonylamino, trialkylsilyl,
aryldialkylsilyl, triarylsilyl, sulfonic acid and
derivative salts, phosphonic acid and derivative
salts, alkoxycarbonylamino, alkylaminocarbonyloxy,
dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl,
alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy,
polyhaloalkynyl, polyhaloalkynyloxy,
polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted

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or substituted arylhydrazonomethyl, a hydroxy group
 condensed with a mono-, di- or polysaccharide,
 haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
 aryloxy, aralkoxy, arylthio, aralkylthio,
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxylphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R₃, = X-R₃.

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or



R_{36} is a substituted or unsubstituted, asymmetrical heterocyclic ring system having at least three nitrogen atoms which is selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or

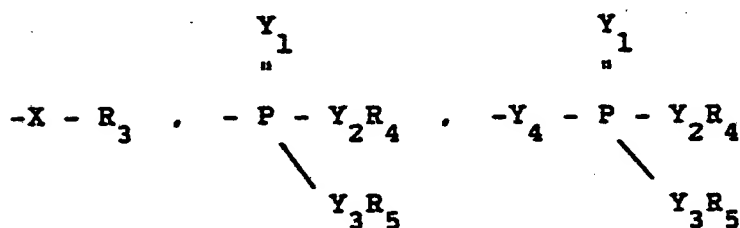
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different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,

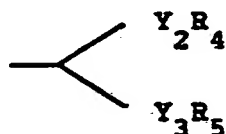
- 780 -

alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium.

$-X, = X, -X = R_3, = X-R_3,$



or



wherein:

R_3 is a substituted or unsubstituted, carbocyclic or heterocyclic ring system selected from a monocyclic aromatic or nonaromatic ring system, a bicyclic aromatic or nonaromatic ring

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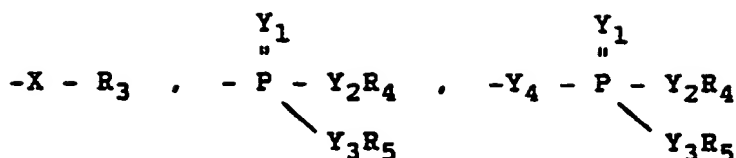
system, a polycyclic aromatic or nonaromatic ring system, and a bridged ring system which may be saturated or unsaturated in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocabonyl, alkylaminothiocabonyl, dialkylaminothiocabonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy,

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polyfluoroalkanol, cyanoalkylamino,
semicarbazonomethyl, alkoxycarbonylhydrazonomethyl,
alkoxyiminomethyl, unsubstituted or substituted
aryloxyiminomethyl, hydrazonomethyl, unsubstituted
or substituted arylhydrazonomethyl, a hydroxy group
condensed with a mono-, di- or polysaccharide,
haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,
aryloxy, aralkoxy, arylthio, aralkylthio,
alkylthioalkyl, arylthioalkyl, arylsulfinyl,
arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
aminosulfonyl, alkylaminosulfonyl,
dialkylaminosulfonyl, arylaminosulfonyl,
carboxyalkoxy, carboxyalkylthio,
alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
alkenylsulfonyloxy, arylsulfonyloxy,
haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
aroylamino, haloacylamino, alkoxycarbonyloxy,
arylsulfonylamino, aminocarbonyloxy, cyanato,
isocyanato, isothiocyano, cycloalkylamino,
trialkylammonium, arylamino, aryl(alkyl)amino,
aralkylamino, alkoxyalkylphosphinyl,
alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
dialkoxyphosphino, hydroxyamino, alkoxyamino,
aryloxyamino, aryloxyimino, oxo, thiono,
alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

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$-X, = X, -X = R_3, = X-R_3,$



or



R_3 is a substituted heteroatom or substituted carbon atom, or a substituted or unsubstituted, branched or straight chain containing two or more carbon atoms or heteroatoms in any combination in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxycarbonylalkyl, alkoxycarbonylalkylthio, polyhaloalkenylthio, thiocyno, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl,

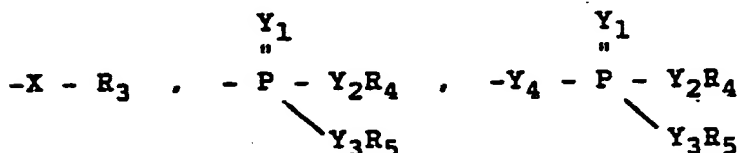
- 784 -

alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl, aryloxy, aralkoxy, arylthio, aralkylthio, alkylthioalkyl, arylthioalkyl, arylsulfinyl, arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl, haloalkenyloxy, haloalkynyloxy, haloalkynylthio, haloalkenylsulfonyl, polyhaloalkenylsulfonyl, alkoxysulfonyl, aryloxysulfonyl, propargyloxy, aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl, aminosulfonyl, alkylaminosulfonyl, dialkylaminosulfonyl, arylaminosulfonyl, carboxyalkoxy, carboxyalkylthio, alkoxycarbonylalkoxy, acyloxy, haloacyloxy, polyhaloacyloxy, aroyloxy, alkylsulfonyloxy, alkenylsulfonyloxy, arylsulfonyloxy.

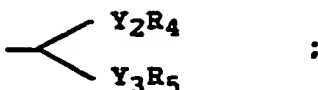
- 785 -

haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxy-carbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R₃, = X-R₃.



or



Y₁ and Y₄ are independently oxygen or sulfur;

Y₂ and Y₃ are independently oxygen, sulfur, amino or a covalent bond; and

R₄ and R₅ are independently hydrogen or substituted or unsubstituted alkyl, polyhaloalkyl, phenyl or benzyl in which the permissible substituents are the same or different and are one or more hydrogen, halogen, alkylcarbonyl, alkylcarbonylalkyl, alkoxy-carbonylalkyl, alkoxy-carbonylalkylthio, polyhaloalkenylthio,

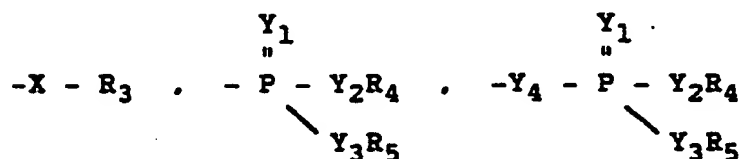
- 786 -

thiocyano, propargylthio, hydroxyimino, alkoxyimino, trialkylsilyloxy, aryldialkylsilyloxy, triarylsilyloxy, formamidino, alkylsulfamido, dialkylsulfamido, alkoxysulfonyl, polyhaloalkoxysulfonyl, hydroxy, amino, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, aminothiocarbonyl, alkylaminothiocarbonyl, dialkylaminothiocarbonyl, nitro, cyano, hydroxycarbonyl and derivative salts, formamido, alkyl, alkoxy, polyhaloalkyl, polyhaloalkoxy, alkoxycarbonyl, substituted amino in which the permissible substituents are the same or different and are one or two propargyl, alkoxyalkyl, alkylthioalkyl, alkyl, alkenyl, haloalkenyl or polyhaloalkenyl; alkylthio, polyhaloalkylthio, alkylsulfinyl, polyhaloalkylsulfinyl, alkylsulfonyl, polyhaloalkylsulfonyl, alkylsulfonylamino, alkylcarbonylamino, polyhaloalkylsulfonylamino, polyhaloalkylcarbonylamino, trialkylsilyl, aryldialkylsilyl, triarylsilyl, sulfonic acid and derivative salts, phosphonic acid and derivative salts, alkoxycarbonylamino, alkylaminocarbonyloxy, dialkylaminocarbonyloxy, alkenyl, polyhaloalkenyl, alkenyloxy, alkynyl, alkynyloxy, polyhaloalkenyloxy, polyhaloalkynyl, polyhaloalkynyloxy, polyfluoroalkanol, cyanoalkylamino, semicarbazonomethyl, alkoxycarbonylhydrazonomethyl, alkoxyiminomethyl, unsubstituted or substituted aryloxyiminomethyl, hydrazonomethyl, unsubstituted or substituted arylhydrazonomethyl, a hydroxy group condensed with a mono-, di- or polysaccharide, haloalkyl, haloalkenyl, haloalkynyl, alkoxyalkyl,

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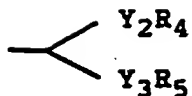
aryloxy, aralkoxy, arylthio, aralkylthio,
 alkylthioalkyl, arylthioalkyl, arylsulfinyl,
 arylsulfonyl, haloalkylsulfinyl, haloalkylsulfonyl,
 haloalkenyloxy, haloalkynyloxy, haloalkynylthio,
 haloalkenylsulfonyl, polyhaloalkenylsulfonyl,
 alkoxysulfonyl, aryloxysulfonyl, propargyloxy,
 aroyl, haloacyl, polyhaloacyl, aryloxycarbonyl,
 aminosulfonyl, alkylaminosulfonyl,
 dialkylaminosulfonyl, arylaminosulfonyl,
 carboxyalkoxy, carboxyalkylthio,
 alkoxycarbonylalkoxy, acyloxy, haloacyloxy,
 polyhaloacyloxy, aroyloxy, alkylsulfonyloxy,
 alkenylsulfonyloxy, arylsulfonyloxy,
 haloalkylsulfonyloxy, polyhaloalkylsulfonyloxy,
 aroylamino, haloacylamino, alkoxycarbonyloxy,
 arylsulfonylamino, aminocarbonyloxy, cyanato,
 isocyanato, isothiocyano, cycloalkylamino,
 trialkylammonium, arylamino, aryl(alkyl)amino,
 aralkylamino, alkoxyalkylphosphinyl,
 alkoxyalkylphosphinothioyl, alkylhydroxyphosphinyl,
 dialkoxyphosphino, hydroxyamino, alkoxyamino,
 aryloxyamino, aryloxyimino, oxo, thiono,
 alkylaminoalkoxy, dialkylaminoalkoxy, alkoxyalkoxy,
 alkoxyalkenyl, cyanoalkoxy, dialkylsulfonium,

-X, = X, -X = R₃, = X-R₃.



or

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106. A composition for reducing moisture loss from plants comprising an acceptable carrier and an effective amount, sufficient to reduce moisture loss from plants without substantially inhibiting plant photosynthetic electron transport, of a compound of claim 105.

107. A composition for increasing crop yield comprising an acceptable carrier and an effective amount sufficient to increase crop yield without substantially inhibiting plant photosynthetic electron transport, of a compound of claim 105.

108. The method of claim 1 in which the compound is used in combination with one or more other biologically active compounds.

109. The method of claim 53 in which the compound is used in combination with one or more other biologically active compounds.

110. A method for reducing moisture loss from soil having plants or crops planted therein which comprises applying to the plant surface or crop an effective amount, sufficient to reduce soil moisture loss without substantially inhibiting plant photosynthetic electron transport, of a compound having the formula

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$$R_1 - X - R_2$$

wherein R_1 , X and R_2 are as defined in claim 1.